ENVIRONMENTAL IMPACT STATEMENT

MODIFICATION OF 40 x 80-FOOT SUBSONIC WIND TUNNEL

Amendment No. 1

To the 1977 Institutional Environmental Impact Statement
For the Ames Research Center

June 1977

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MODIFICATION OF THE
40- BY 80-FOOT
SUBSONIC WIND TUNNEL

AMES RESEARCH CENTER
Moffett Field, California 94035

National Aeronautics and Space Administration

SUMMARY

( ) Draft

(X) Final Environmental Statement

Responsible Federal Agency: National Aeronautics and Space Administration
Ames Research Center
Moffett Field, CA 94035

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1. Name of Action:

(X) Administrative Action
( ) Legislative Action

2. Brief Description: NASA proposes to modify the existing 40- x 80-foot subsonic wind tunnel at Ames Research Center (ARC), Moffett Field, California, to provide a national facility for testing full-scale aircraft systems under simulated flight conditions. Tunnel construction activities will be divided into two phases: ground clearance and excavation activities, and tunnel erection and fabrication. These construction activities are estimated to encompass an approximate 21-month period. The modified 40- x 80-foot test section would be operated a total of approximately 300 hours per year (100 hours per year at test speed) with test section speed ranges up to 300 knots, and the proposed additional 80- x 120-foot section would be operated a total of approximately 450 hours per year (150 hours per year at test speed) with test section speed ranges up to 110 knots.

3. Summary of Environmental Effects: Environmental effects associated with the proposed action would be: slight decrease in habitat for a few cosmopolitan species of fauna; slight traffic interruptions; slight increase in emission of air pollutants; slight visual impact, a potential for an effect on subsurface archaeological remains; slight decreases in the

noise environment of the Naval housing southwest of the tunnel and around the northern and southern portions of the Naval housing west of Moffett Boulevard.

4. Summary of Major Alternatives: Alternatives considered include: no modification; alternative sites for the 80- x 120-foot test section at Ames; alternative facilities which could be constructed at Ames; alternative facilities which could be constructed elsewhere; and flight testing in lieu of wind tunnel testing.

5. Comments on the draft were requested from:

Regional Administrator IX
U.S. Environmental Protection Agency

Office of Federal Activities
U.S. Environmental Protection Agency

Moffett Field Naval Air Station

Department of the Navy

Environmental Project Review
Department of the Interior

Office of Architectural and Environmental Preservation
Advisory Council on Historic Preservation

Advisory Council on Historic Preservation

Office of Environmental Affairs
Department of Health, Education and Welfare

Office of Environmental Quality
Department of Housing and Urban Development

Office of Environmental Quality
Department of Transportation

California State Water Resources Control Board

California State Department of Fish and Game, Region III

California State Lands Commission

California State Department of Public Health

California State Air Resources Board

California State Historic Preservation Office
Resource Management and Protection Division
Department of Parks and Recreation

California State Department of Transportation

California State Office of Planning and Research

California Regional Water Quality Control Board
San Francisco Bay Region

San Francisco Bay Conservation and Development Commission

Association of Bay Area Governments

Bay Area Air Pollution Control Board

Santa Clara Valley Water District

Santa Clara County Board of Supervisors

Santa Clara County Planning Commission

City of Palo Alto

City of Mountain View

City of Sunnyvale

City of Menlo Park

6. Submittal Date: Draft statement submitted to Council on Environmental Quality (CEQ) Executive Office of the President, and made available to the public in November 1976. Final statement submitted to CEQ and made available to the public on JUL 5 1977.

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1.1 Description of Proposed Action

NASA proposes to modify the existing 40- x 80-foot subsonic wind tunnel at Ames Research Center (ARC), Moffett Field, California, to provide a national facility for testing full-scale aircraft systems under simulated flight conditions. The existing 40- x 80-foot wind tunnel has a single test section 40 feet high, 80 feet wide, and 80 feet long, and its main drive consists of six 6,000-horsepower motors capable of producing a maximum test section velocity of nearly 200 knots. The location of the existing facility relative to the surrounding area and other facilities at Ames is shown in Figure 1.

The proposed action includes land acquisition, repowering of the existing 40- x 80-foot wind tunnel test section, construction of a new 80- x 120-foot test section, and the eventual operation of these facilities.

Land Acquisition

Ames Research Center owns most of the land required for the proposed action. There is, however, one small piece of property in the construction area which will be acquired from the Navy. There are also 5 acres of Pacific Gas and Electric (PG&E) Company property in the area of construction -- NASA will acquire this property by exchanging, with PG&E, 5 acres of NASA property of equal value.

Repowering the Existing Facility

The repowering of the 40- x 80-foot test section of the Ames Wind Tunnel will be accomplished by replacing the six existing 6,000-horsepower motors with 18,000-horsepower motors, providing new variable pitch fans,

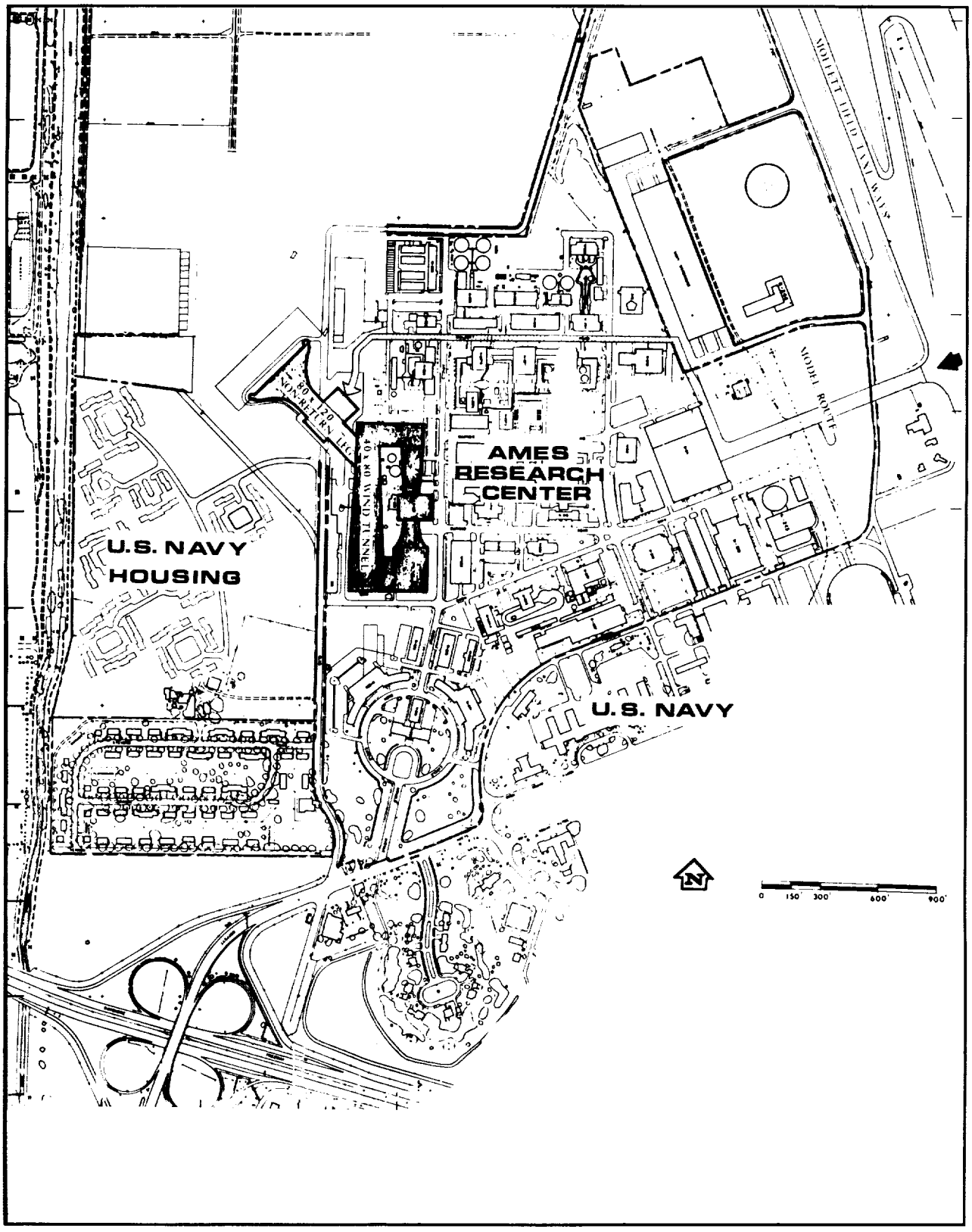

Figure 1. VICINITY MAP OF AMES RESEARCH CENTER

increasing the power supply, and strengthening the existing motor support and airflow structures. These modifications will be contained within the present 40- x 80-foot wind tunnel structure and will increase the velocity capability from 200 to 300 knots.

Construction of the New Test Section

The new 80- x 120-foot test section, with a maximum test speed of 110 knots, will be constructed adjacent to and integrated with the existing 40- x 80-foot wind tunnel building (Fig. 2). A detailed description of the proposed construction is provided in Appendix A.

Construction activities include: wind tunnel erection and fabrication, relocation of portions of the ARC substation, relocation of the ARC 18-inch water main, relocation of the 15-inch sewer collector from the Naval Housing area, construction of a model access road, construction of an underground fuel storage tank, construction of an asphalt-treated apron in front of proposed test-leg intake, demolition of the farm buildings on ARC property, demolition of Building N-224 and portions of Building N-223 at Ames, removal of overhead utility lines and poles.

Wind Tunnel Operations

The modified 40- x 80-foot test section will be utilized for about 85 days per year (the key-on time will be about 300 hours per year and the time at test speed will be about 100 hours per year). The new 80- x 120-foot test section will be utilized for about 120 days per year (the key-on time will be about 450 hours per year and the time at test speed will be about 150 hours per year). The proposed facility will be constructed such that either the 40- x 80-foot section would operate or the new 80- x 120-foot section, but not both at the same time.

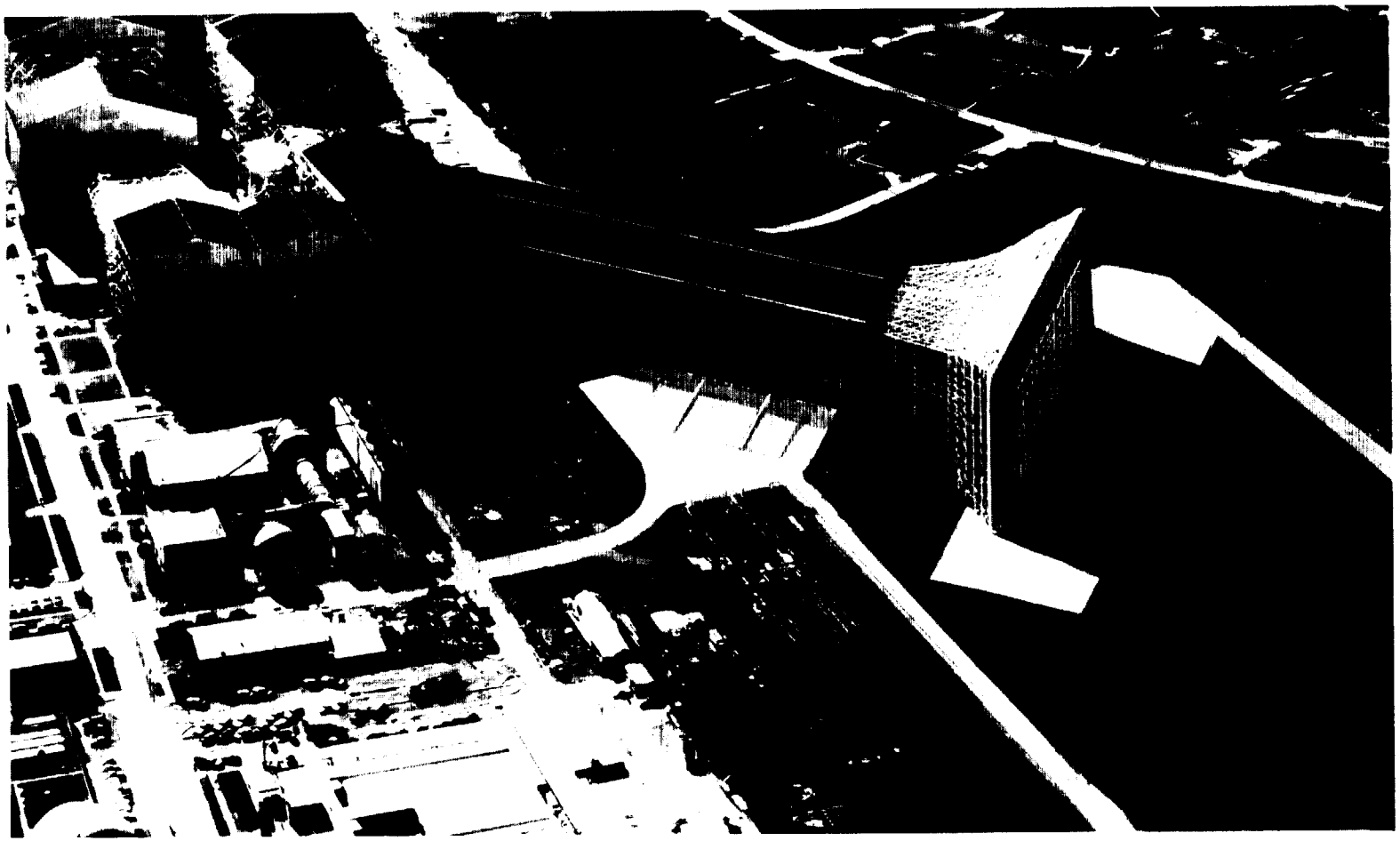

Figure 2. MODIFICATIONS TO 40- x 80-FOOT WIND TUNNEL

1.2 Statement of Purpose

In civil aviation, studies of advanced rotorcraft at their higher cruise speeds and studies of the capabilities of full-scale V/STOL aircraft are important in minimizing structural and associated safety problems, in reducing aircraft noise during landing and take-off, and in improving flight performance of airplanes in congested terminal areas; these are all factors that strongly affect the impact of air transportation systems on their environmental surroundings and on total energy consumption. Military operations also impose stringent requirements on landing and take-off performance of rotorcraft and V/STOL aircraft. The proposed 40- x 80-foot wind tunnel modification will enable more rapid and more extensive development of significantly improved aircraft systems in both civil and military sectors.

Repowering the tunnel is essential for adequately studying rotorcraft at their cruise speeds. The main technical problem areas for rotorcraft are rotor control, dynamic loads, and performance at high flight speeds. These problem areas are critically dependent on Mach number, Reynolds number, and advance ratios; therefore, wind tunnel tests must be conducted at flight values of these parameters if they are to be very meaningful. Even for relatively modest distances, speeds of 250 knots and above are required for economic operation of rotorcraft, hence the importance of a test capability of at least 300 knots.

The need for a larger subsonic test section is based on: (1) the growth in size of aircraft since the 40- x 80-foot wind tunnel was designed, and (2) types of aerodynamic and structural problems that cannot be adequately solved by the use of small-scale models. For conventional aircraft this includes the performance of high-lift devices, which are Reynolds number sensitive and difficult to reproduce accurately at small scale. Also, there are mechanical and structural aspects of high-lift systems such as leaks, deflection under load, etc., that can significantly affect aerodynamic performance.

For V/STOL aircraft, the main problems are usually the propulsion system and its interface to the aircraft. The main components of the propulsion system (rotor or fan blades, inlets, vectoring devices, etc.) operate in the range of Reynolds numbers where significant variations in aerodynamics occur. In addition, there are important aeroelastic, mechanical, and structural aspects of these propulsion systems that require extensive experimental studies using full-scale or flight hardware. The major technical risks for V/STOL aircraft employing low-disk-loading rotor systems are associated with dynamic loads, dynamic stability, and control of the rotor system. These characteristics are highly dependent on the unsteady aerodynamic force inputs to the rotor and on the dynamic characteristics of the rotor and its control system (including backlash, break-out forces, non-linear effects, etc.). For V/STOL aircraft employing high-disk-loading, direct-lift propulsion systems, the main problem areas are in hovering and in the transition to and from wing-supported flight. In this transition flight regime, the lift propulsion system is generally required to operate in a highly distorted, unsteady, and turbulent flow field, with resulting high vibratory loads on fan blades, and possible catastrophic failures in flight due to fan or engine stalling. It is therefore essential that the characteristics of the propulsion system as installed in the aircraft be determined in groundbased facilities prior to committing the hardware to flight. Failure to do this may result in serious deficiencies not being discovered until the aircraft is flown, with expensive and possibly catastrophic results.

2.0

EXISTING ENVIRONMENT

2.0 EXISTING ENVIRONMENT

2.0 General Description

A description of the regional and local environment surrounding Ames Research Center is contained in the final Institutional Environmental Impact Statement (EIS) dated June 1977. The Institutional EIS also includes a complete listing of all facilities and operations at Ames. Because the above information is contained in the Institutional EIS, the description of the environment in this amendment will be limited to a discussion of the relationship of the existing 40- x 80-foot wind tunnel to the local and regional (if necessary) environment.

2.2 Soils and Geology

The following description of the existing geologic environment in the vicinity of the proposed extension to the 40- x 80-foot wind tunnel was taken largely from two previous geologic and foundation investigations at the Ames Research Center site. Descriptions contained in these reports were supplemented with published maps and reports of the U.S. Geological Survey, U.S. Soil Conservation Service, and the California Division of Mines and Geology. As the revised Institutional EIS contains a detailed discussion (including figures) of the soils, geologic units, and seismic setting of the ARC and its environs, they will not be discussed below.

A total of 12 test borings ranging in depth from 15 feet to 150 feet have been drilled in the immediate vicinity of the project site. These borings have provided a more detailed picture of the subsurface conditions at the project site. The subsurface geologic conditions revealed by these test borings are summarized below.

A very stiff, highly plastic, black silty clay blankets most of the ARC, including the entire project site. Locally called "adobe," this surficial deposit is generally about 5 feet thick. Beneath the surficial clay layer, to approximately 100 feet, the sediments consist mainly of medium to very stiff silty clay interlayered with thin seams and lenses of medium, silty, fine- to medium-grained sand. Some sand layers up to 15 feet thick occur in the first 50 feet but most are less than 5 feet thick. Below the 100-foot depth, the sediments consist primarily of very stiff clay.

Field and laboratory tests run on samples taken from the test borings indicated that the engineering properties of the unconsolidated sediments are highly variable. The clay blanket is highly plastic and

highly expansive. It undergoes large seasonal changes in volume with fluctuations in moisture content. When saturated under low confinement, it becomes weak.

The engineering characteristics of the silty clay sediments underlying the heavy clay blanket vary both laterally and with depth. Clay strengths generally increase with depth to about 65 feet below the surface where a slight reduction in shear strength is indicated. Clay strengths then increase again with further depth.

Geologic hazards, as discussed in this report, are defined as geologic conditions and naturally occurring geologic events which could have an adverse impact upon the proposed project. By contrast, "geologic impacts" are defined as the potential environmental problems the proposed project could create, either directly or as a result of a geologic hazard. The following potential geologic hazards are discussed regardless of the fact that the geologic limitations at the project site can be mitigated by sound engineering practices.

Potential geologic hazards at the site of the proposed 40- x 80-foot wind tunnel extension include earthquake shaking, liquefaction, differential settlements, expansive and compressible soils, and areal subsidence. Since there are no known active fault traces on the ARC or in the immediate area, the hazards of fault rupture and tectonic creep are considered remote. Due to the essentially flat terrain, problems of slope failure and excessive erosion are considered insignificant. The site lies well beyond the area that may be inundated by a tsunami wave.*

Because of the seismic activity of the San Francisco Bay Area, the major geologic hazards at the project site are related to ground shaking during an earthquake and the effect this has on the underlying sediments and the proposed structure.

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*Based on a tsunami wave with a runup of 20 feet at the Golden Gate Bridge.

Liquefaction

The liquefaction of sediments underlying the project site has not been completely evaluated, but it is not expected to be a serious problem. A few localized sand layers have the potential for liquefaction, but they are discontinuous and are surrounded and covered by clay. Piles will carry the structural loads below these layers. Consequently, if liquefaction occurs within these local zones, it should not seriously affect the proposed structure. Displacements of the ground surface, which would affect shallow foundations and slabs, are expected to be small and of minor consequence for these structures.

Lurch Cracking

Irregular fractures, cracks, and fissures in the ground surface often occur in weathered rock, alluvium, and soil due to the settling, shaking, and passage of surface earthquake waves during a strong earthquake.

The most serious damage resulting from lurch cracking will be in areas underlain by mud and artificial fill; it is not expected to be a problem at the project site.

Ground Shaking

In addition to the above described phenomena which are precipitated by ground shaking, the ground motion itself can be a hazard to the works of man. The extent of the ground-shaking hazard is dependent primarily on the characteristics of the structure and the underlying soil. Thus, in large measure, the potential damage of ground shaking is ultimately determined by the foundation and building design utilized. Since the ground motion response characteristics of the proposed structure have not been determined at the writing of this report, an evaluation of the

ground-shaking hazard for the project could not be made. However, because of the similarity of the new and modified structure to that of the existing 40- x 80-foot wind tunnel, which has been in place for over 30 years, it is not expected that this hazard will present any new problems in the design.

Differential Settlement

The static weight of the proposed structure would compress the underlying sediments. However, the differential and total settlements due to static loading are expected to be tolerable for the proposed pile foundation.

Areal Subsidence

The overdraft of groundwater from the unconfined aquifer in the Santa Clara Valley has resulted in a large area of land subsidence. In the vicinity of the ARC, several feet of subsidence occurred during the period 1934 to 1967. However, since 1965, increased artificial recharge of the aquifer together with decreased pumping from confined aquifers has virtually halted subsidence in the Santa Clara Valley.

Problems caused by areal subsidence are limited primarily to lengthy linear structures such as canals, sewer lines, storm drains, and water mains in which slight changes in surface elevations may cause flow problems. Thus, if another cycle of subsidence in the Santa Clara Valley is initiated by over-pumping, it should have little if any effect on the proposed project.

Expansive Soils

The silty-clay soil that covers much of the ARC including the project site is classified by the U.S. Soil Conservation Service as

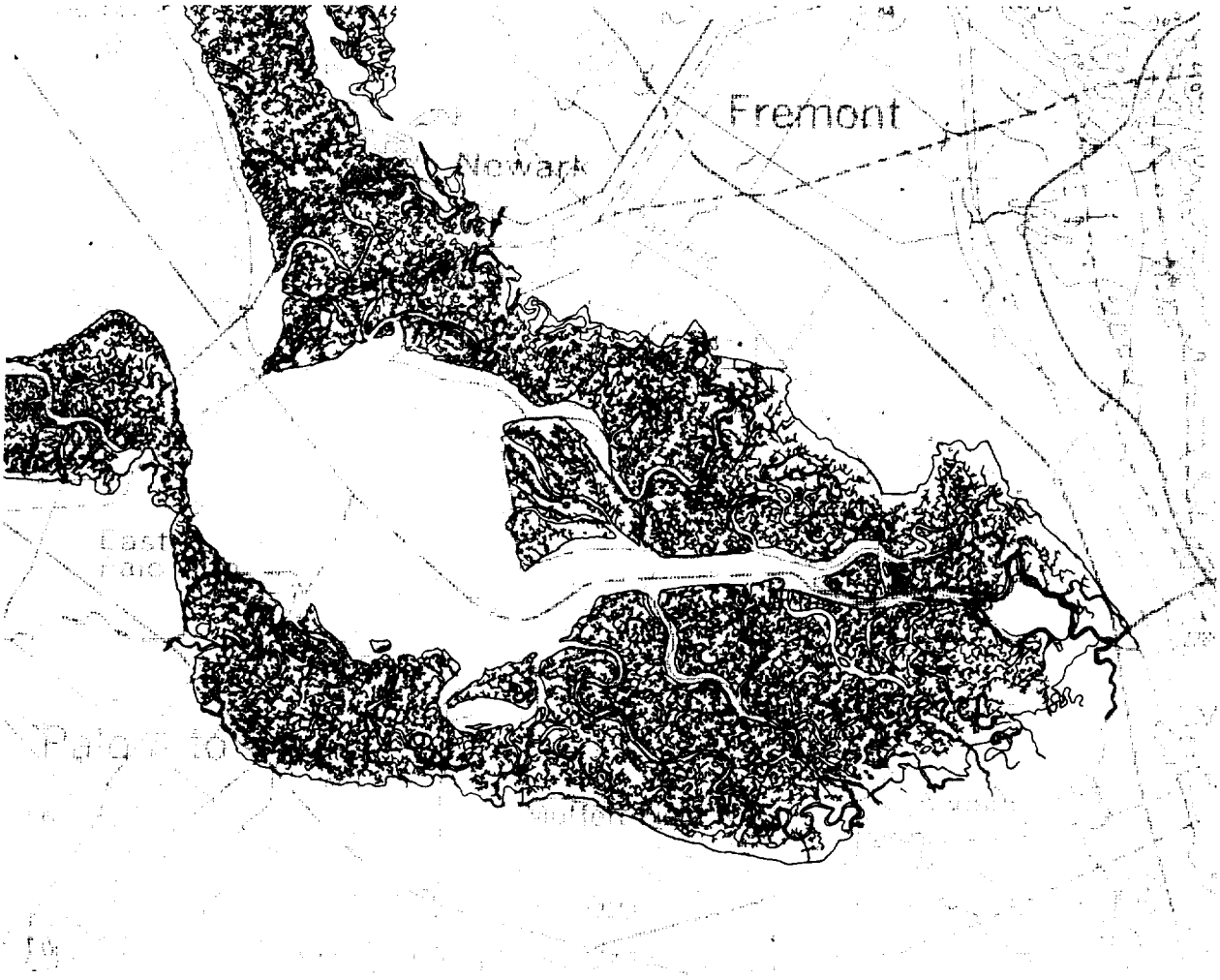
having a high shrink-swell potential. Analysis of soil samples taken from test borings at the project site indicates that approximately the upper 4 feet of soil are highly expansive.

The expansive soils contain certain clays which greatly increase in volume when wetted and shrink when they dry out. Thus, shallow slab foundations, floor slabs, and pavement placed upon these soils will rise and fall seasonally with fluctuation in the shallow water table. The amount of vertical movement often varies from place to place, thus creating stress on the overlying rigid slabs, often causing them to crack and heave. Since a pile foundation is planned for the wind tunnel extension, the expansive soil would have no effect on the foundation of the new structure. However, unless proper mitigating measures are employed, problems related to expansive soils can be expected for the ramp or model preparation area where a rather large area of pavement is required. The potential limitations created by the presence of expansive soils are not considered serious since preventive measures can be employed with little difficulty. Examples of common preventive measures include removal of all or part of the expansive soil layer and placement of a gravel blanket beneath the concrete slab.

2.3 Archaeology

As noted in the Institutional EIS, no federal or state landmark of historic significance is located within the ARC. With regard to the project site, previous farming of the area and other disturbances render surface surveys of the proposed project site inconclusive. Consequently, no surface remains of historic or archaeologic significance were found on the site. Borings of the site have been made for the geologic study, but these did not indicate archaeologic remains.

Although no direct archaeologic evidence has been found or historically recorded for the exact site, the occurrence of archaeologic resources at other sites in the South Bay indicates a potential for encountering remains during the project construction (see Institutional EIS for a map of archaeologic and historic features in the vicinity of the ARC). The project site lies within 1 mile of the historic shoreline (Fig. 3) of marshes and of Stevens Creek before channel modification. This area would have had a direct access to fresh water in Stevens Creek and to fish, waterfowl, and shellfish in the creek and in the Bay's mudflats and marshes. Most bayshore sites contain large amounts of shells (the midden), some human burials, and characteristic blackened soil that can be distinguished in well logs.



EXPLANATION

Edge of marshland in the mid-1800's
(Dashed where approximate)

Tidal sloughs and channels in the mid-1800's

SCALE 1:125 000

2 0 2 4 6 8 10 MILES

2 0 2 4 6 8 10 KILOMETERS

CONTOUR INTERVAL 200 FEET
DATUM IS MEAN SEA LEVEL

Figure 3. HISTORIC SHORELINE OF SOUTHERN SAN FRANCISCO BAY

2.4 Water

A detailed description of the water environment at or near the ARC is contained in the Institutional EIS. Among other things, that section characterizes the quality and quantity of water found in local drainage courses, bays, and groundwaters. As was mentioned in that report, the ARC's activities have very little effect on either surface or groundwater quality or quantity; the impact of the existing 40- x 80-foot wind tunnel on the water environment is consequently negligible.

These negligible effects include a slight reduction in groundwater replenishment below the site, a corresponding increase in surface run-off volume from the site and a decrease in surface water quality from the site. Decreases in groundwater replenishment and increases in surface water runoff volumes are due to the coverage of the approximately 10-acre existing site with impervious surfaces; the ARC, as a whole, occupies about 420 acres of land. However, runoff from the ARC does not reach the Bay, but is collected in surface evaporating ponds in the northern areas through an existing storm drainage system.

2.5 Air

The present 40- x 80-foot wind tunnel contributes small amounts of various pollutants to the air from testing of models with their jet engines running. Because a variety of engines are tested, the emission rates vary considerably from test to test. Emissions from models are circulated and not released until purging takes place. Testing is performed on an average of 4 hours per 16-hour working day. Engines are run intermittently during this period. The variation in mode of operation (engine speed) is most realistically approximated by the standard landing/take-off cycle.

Industrial safety standards presently regulate the concentrations of gases inside the tunnel. Carbon monoxide is the gas most closely watched from this standpoint. Odorous hydrocarbons are also a noticeable emission.

There are likely high emission concentrations immediately adjacent to the exhaust vents when purging takes place. The standard procedure is to purge the tunnel if either the inside concentration or temperature rise becomes excessive (after approximately 2 hours of testing). Purging usually takes 15 to 30 minutes. The exhaust and intake doors are opened, and the fans are run at a low speed.

There are no receptors in the immediate area of the exhaust vents which would be subjected to any temporary high concentrations. Vented gases are transparent and do not violate any opacity standards for stationary sources. They are also warmer than the outside air. This gives them buoyancy which lifts them away from the ground. Dilution to ambient levels takes place rapidly.

Emission of pollutants historically has never been a problem for the 40- x 80-foot wind tunnel. The tunnel has now operated for almost

30 years without any air quality complaints. Indeed, the entire ARC as a whole has very little impact on air quality, although as noted in the Institutional EIS, the emission of oxides of nitrogen (NO_x) at the ARC may cause the Federal 1-hour NO_2 standard to be exceeded at least once per year at the site. For more information regarding other climatological and air quality characteristics of the local area and the ARC, the Institutional EIS should be consulted.

2.6 Biology

The proposed modifications will be built on land which is presently utilized for agriculture or plowed in order to control weed growth for fire control and security. Vegetation of the site is therefore comprised either of truck-farm crops of very early successional stages of recolonization by weed species (thistles, mustard, bur clover, etc.). Because of frequent plowing for weed control and cultivation, rodents, rabbits and ground-nesting birds, which would normally be found in an area undergoing vegetative succession, are excluded for most of the year.

It should be noted that the Institutional EIS contains a complete description of the biotic resources in and around the ARC as well as a list of aquatic and terrestrial plants, animals, and birds which might be found at or near Ames. As was noted in the above document, several rare and endangered species have been reported in the surrounding areas and could be expected to occur on or immediately adjacent to the ARC; however, the likelihood of their occurrence at the proposed site is low, because of agricultural cultivation.

2.7 Noise

As was mentioned in the Institutional EIS, there are a number of noise-sensitive areas in the vicinity of the 40- x 80-foot wind tunnel. The only residential areas near the wind tunnels are medium-density Naval Dependent Housing and a trailer park complex. The Naval Dependent Housing units are in two general locations north of Bayshore Freeway -- east of Moffett Boulevard and west of the 40- x 80-foot wind tunnel. The trailer park is located to the west of Stevens Creek and north of L'Avenida Street. Because of the closeness and intensity of wind tunnel noise, the Navy has received some complaints from Navy residents to the west of the tunnel and west of Moffett Boulevard. The location of these noise-sensitive areas is shown in Figure 4.

Under the Family Housing Master Plan, the area to the west of the tunnel is considered by the Navy to be the primary building site for future housing; however, this is dependent upon shortage of other housing in the local area and Congressional appropriations. If development occurs in this area, noise from the proposed wind tunnel project may impact the new residential area.

The other possible noise-sensitive areas in the vicinity of the wind tunnel are offices at the ARC, Navy offices at Moffett Field, and residential housing to the south of Bayshore Freeway. ARC offices are scattered throughout the facility, mostly to the south and east of the 40- x 80-foot wind tunnel. Navy offices are primarily located between Ames and Naval Housing north of Bayshore. The residential housing to the south of Bayshore is scattered throughout that area. However, none of the residents of these locations, to our knowledge, have complained about the noise from the 40- x 80-foot wind tunnel. The location of these areas is also shown in Figure 4. The remaining areas around the tunnels are industrial, commercial, or open space, thus less sensitive to noise.

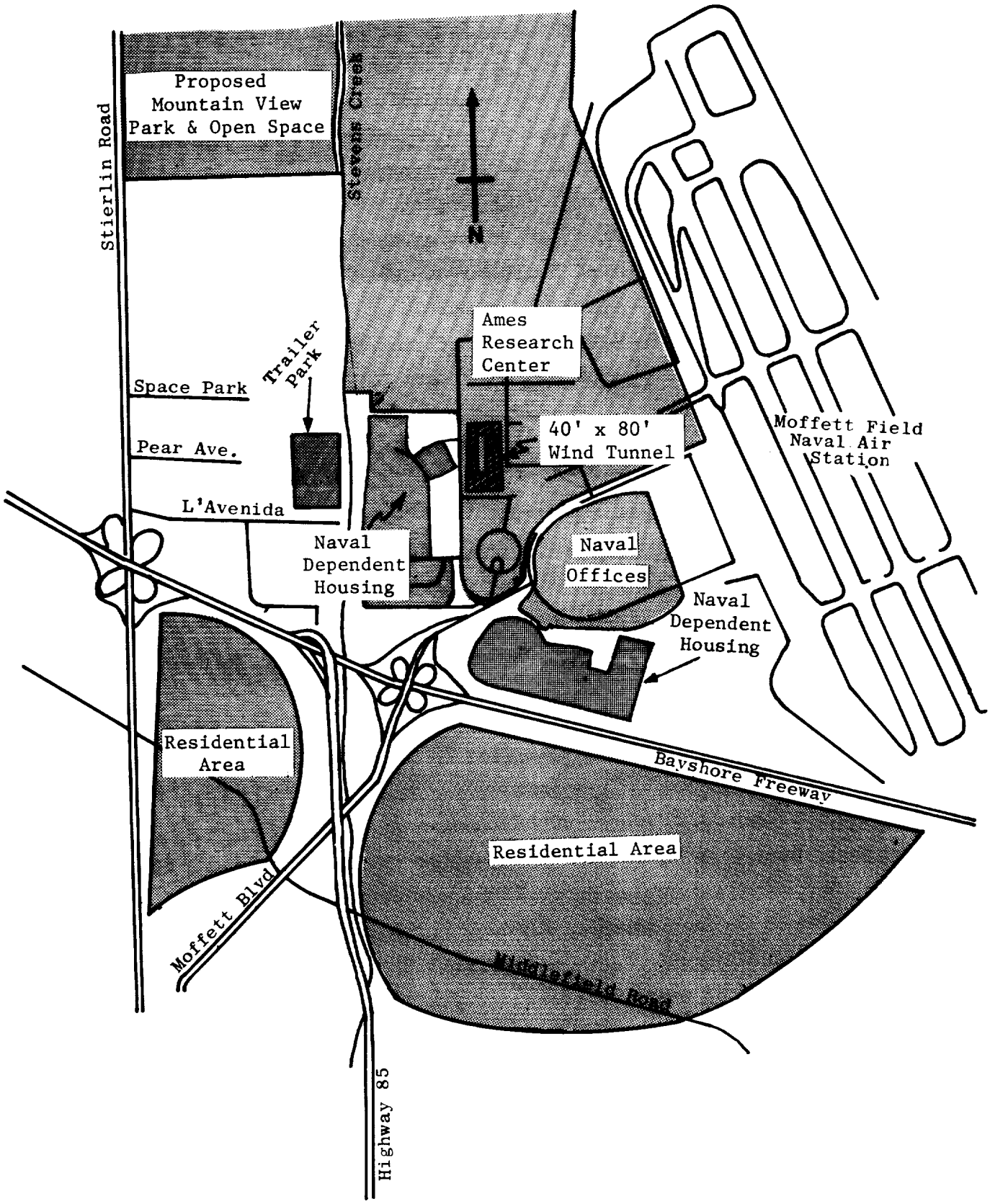


Figure 4. POSSIBLE NOISE SENSITIVE AREAS NEAR THE 40- x 80-FOOT WIND TUNNEL

The somewhat infrequent complaints attributed to the present 40- x 80-foot wind tunnel are primarily associated with noise from nighttime testing and vibration (the tunnel operates with two 8-hour shifts ending at midnight). Most of these complaints come from the Naval Dependent Housing residents. The noise generated by this tunnel is predominantly low frequency centered at 31.5 Hz and 63 Hz.

The existing facility operates about 208 days a year. This is based upon fifty-two 5-day work weeks less allowance for holidays, with an average test cycle of 12 work days, two of which are downtime. As noted in Table 1, the existing facility is at test speed for about 330 hours per year, or an average of 1.6 hours per test day. About 11 percent of the operational time (37 hours per year), the facility is operating with a maximum speed in the test section and generates the noise levels shown in Figure 5. The noise levels in the Naval Dependent Housing to the west and southwest of the tunnel vary from 60 to 80 dBA when the tunnel is operating at maximum speed (Fig. 5). Compared to the 56-dBA annual ambient attributable to all other noise sources, the tunnel noise levels are from 4 to 24 dBA higher, and clearly dominate the noise environment when the tunnel is operating at top speed (11 percent of the time). When the full range of tunnel speeds is considered, tunnel noise equals or exceeds the normal ambient in the southernmost portions of the Naval Dependent Housing area about 30 percent of the time the tunnel is operating. The percentage is about 60 percent for that portion of the Naval Dependent Housing closest to the tunnel. A similar result is obtained for the ARC facilities north and south of the tunnel. ARC facilities to the east have noise levels equal to or greater than the ambient about 40 percent of the time the tunnel is operating because the ambient in this area is somewhat higher.

The second factor that causes complaints from residents close to the wind tunnel is low frequency vibrations. Of particular concern,

Table 1

UTILIZATION OF EXISTING FACILITY

TEST SECTION SPEED RANGES (knots)	TIME AT TEST SPEED IN 40 x 80 TEST SECTION (hours/year)
0-30	18.51
30-40	18.51
40-50	18.51
50-60	18.51
60-70	18.51
70-80	18.51
80-90	18.51
90-100	18.51
100-110	18.51
110-120	18.51
120-140	37.03
140-160	37.03
160-180	37.03
180-200	37.03
TOTAL	333.22

Source: NASA-ARC, 1976.

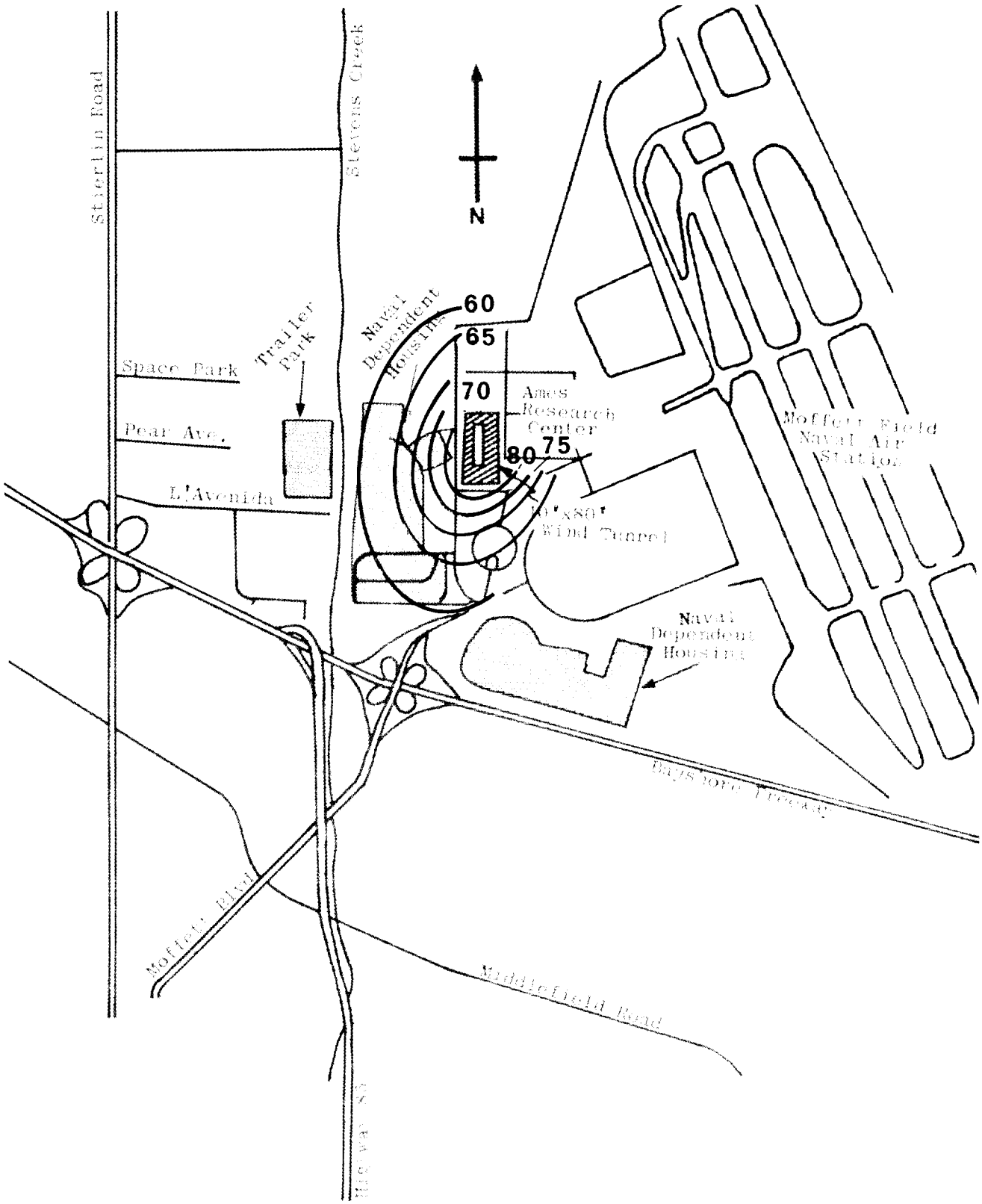


Figure 5. PEAK NOISE LEVELS FOR EXISTING FACILITY, dBA

reported by some Moffett Field officials, are wooden and metal sash windows and sliding glass doors which vibrate loose. These, in turn, generate their own noise within the dwellings.

The average running time (key-on) of the 40- x 80-foot wind tunnel is slightly in excess of 4-1/2 hours per working day. Of that time, about 3 hours is utilized in starting and stopping the facility; thus, the wind tunnel noise level changes gradually, which tends to minimize the startle reaction created by sudden noisy events (e.g., sonic booms, explosions, brake squeals, etc.).

When the present 40- x 80-foot wind tunnel is in full operation, the noise environment of the Naval Dependent Housing to the west of the tunnel may exceed those recommended levels thought necessary to avoid speech and sleep interference because some testing is done in the evening or night when quieter levels are expected by the residents.

In other areas, tunnel noise does not dominate the noise environment, but does contribute and is occasionally audible. Tunnel noise should not be audible south of Bayshore Freeway except at night and when unusual meteorological conditions promote the transmission of sound waves, although it should be noted again that no complaints have been received from these residents.

As discussed in the Institutional EIS, the current noise environment of the Naval housing area from vehicle traffic on Bayshore Freeway ranges from acceptable to unacceptable, according to HUD and DOT guidelines, and EPA recommended levels. As noise from freeway traffic dominates ambient noise conditions, distance of the housing from the freeway is the deciding factor, the dwellings closest to the freeway being an unacceptable noise environment and the farther dwellings being in an acceptable noise environment.

Moffett Field Naval Air Station has approximately 50,000 flight operations a year, about 98 percent of which occur during daylight hours. Although aircraft operations at MFNAS are a significant source of community complaints, the airfield probably has a lower number of complaints than similar airports in other metropolitan areas due to the type of aircraft operating from the base (turboprop-powered P-3 Orions). The noise environment associated with Moffett Field operations is within the HUD and California guidelines (CNEL) of 65 dB for the residential areas. However, peak noise levels from individual aircraft flyover frequently exceed the recommended levels for speech and sleep interference and, as noted in the Institutional EIS, Aircraft Operations at Moffett Field do result in community complaints, generally from residential areas south of Bayshore Freeway.

2.8 Transportation

A full discussion of the existing transportation environment is contained in the Institutional EIS. As was noted in that document, approximately 87.5 percent (or about 7,100) of the average daily vehicular trips (ADT) associated with Ames activities use Moffett Boulevard. Of that 7,100, approximately 4,760 trips (or 67 percent) enter or leave ARC through Gate 18, while the remaining 2,330 (or 33 percent) pass through the Main Gate into Moffett Field. Ames trips entering or leaving ARC through Gate 18 amount to about 90 percent of the total trips using that portion of Moffett Boulevard, while the number of Ames trips through the Main Gate represents about 12 percent of the total traffic through that gate.

Given the above background, the fact that about 100 people are associated directly or indirectly with the wind tunnel and the assumption that each individual makes two trips per day -- a total of 200 trips/day can then be attributed to operation of the 40- x 80-foot wind tunnel -- the effect of the 40- x 80-foot wind tunnel can be calculated. For instance, less than 1 percent of the total ADT using Moffett Boulevard to enter or leave either ARC or Moffett Field can be attributed to traffic generated by 40- x 80-foot wind tunnel personnel, while trips generated by 40- x 80-foot wind tunnel personnel account for only 4 percent of the traffic using Moffett Boulevard to enter or leave ARC through Gate 18.

2.9 Utilities

Electrical Power and Energy Use

Ames contracts with PG&E and with the Bureau of Reclamation for its electrical power needs. Some of this power is generated by the U.S. Bureau of Reclamation and transferred over PG&E transmission lines under contract with the Federal Government; power in excess of that supplied by the Bureau of Reclamation is purchased from PG&E. This power is transmitted by 115-kv transmission lines on four parallel sets of steel towers on PG&E property to the Ames substation. The Ames substation provides the 40- x 80-foot wind tunnel with 6,900-volt underground service.

The technical load (i.e., that used in direct support of test efforts) of the 40- x 80-foot wind tunnel is approximately 26,000 kva, required by the drive system consisting of six 6,000-hp-rated wound rotor induction motors which in turn are speed-regulated by motor generator sets. These are served by the 6,900-volt circuit. The building load of approximately 700 kva is provided by a 1,000-kva transformer within the "courtyard" of the 40- x 80-foot building, which steps down the voltage to 480 volts.

Technical loads of the Center are scheduled to keep peak power demands as low and as steady as possible. Contractual limits for the Center are 175 mw for daytime and 260 mw for nighttime. To avoid exceeding these limits, it is necessary to schedule around those facilities, such as the Unitary wind tunnel, which have extraordinarily high power consumption. The existing 40- x 80-foot wind tunnel, being only a minor power consumer, can run concurrently with any but the largest competing test facilities. In no case in recent years has Ames been required to cancel or halt scheduled tests because of system power shortages or brownouts.

A 12-kv overhead line parallels Moffett Boulevard outside of the Ames facility. This distribution line presently serves the farm on the Ames property as well as one PG&E customer across Stevens Creek. This line also contains signalling circuits. The Ames underground electrical duct bank, which is part of the building power main loop system, is located in close proximity to the northwest corner of the 40- x 80-foot wind tunnel.

Ames, like all government facilities, has an energy savings program in effect which results in reduced power consumption by all facilities. In addition, as noted above, technical loads utilize off-peak power which lowers costs and mitigates the requirement for additional generating capacity on the part of the utility.

Presently, the 40- x 80-foot wind tunnel uses about 6,000 mw-hours per year of electrical energy. The ARC presently uses about 315,000 mw-hours per year.

Water

Water is supplied to Ames and the adjoining Navy facility by 18-inch and 20-inch supply mains which connect to the San Francisco Water Department mains. Long-term contract assures this supply. The 18-inch supply main parallels Moffett Road (with an inset necessitated by the placement of four PG&E transmission towers), with a small 6-inch main extending to the farm area and the 18-inch main terminating in a 12-inch main which serves the still undeveloped portion of Ames. Ames also has storage capacity of 200,000 gallons in an elevated tank and 750,000 gallons in a surface tank; these are located within the "courtyard" of the 40- x 80-foot wind tunnel but do not serve it directly. The 40- x 80-foot facility is served by a 4-inch water main which provides for the building load of the approximately 100 employees.

Five fire hydrants provide protection on the periphery of the 40- x 80-foot tunnel and one hydrant protects the interior courtyard.

Sanitary Sewer

That portion of the Ames facility in which the 40- x 80-foot tunnel is located is served by a 27-inch City of Mountain View sewer main running parallel to Moffett Boulevard. This main in turn connects with a 33-inch Mountain View trunk Line which eventually pumps the sewage to the Palo Alto treatment plant.

Sanitary sewage from the 40- x 80-foot wind tunnel building, which serves its some 100 employees, is collected in 6- and 8-inch pipes which flow to an 18-inch main which joins the 33-inch line. No unusual loads or toxic substances are encountered.

Other Utilities

Ames has a variety of other support utilities including communications, natural gas, fire alarm and safety detection systems. It also has internal utilities such as chilled water, compressed air, and nitrogen.

Communications equipment, except for underground cables, is furnished, installed and maintained by Pacific Telephone and Telegraph (PT&T) under a service agreement with Ames. Ames, however, does any major cable maintenance. A PT&T telephone service line runs on the same pole as the 12-kv electrical service on the westerly side of Moffett Boulevard; it now serves only the farm area.

The natural gas distribution system is owned and operated by Ames. The gas is supplied by the PG&E, although Ames maintains a central liquefied petroleum gas standby plant.

The fire alarm system and safety detection system are separate systems with a central reporting station, and are owned by Ames and operated by its personnel.

All of the above utilities are supplied to the existing 40- x 80-foot wind tunnel as a part of the normal building load.

2.10 Visual Quality

The purpose of this section is to describe the current Ames wind tunnel test facility as it is viewed from long-range, mid-range, and immediate perspectives. The existing structure housing the wind tunnel test facility is approximately 400 feet in width, 900 feet in length and 150 feet high, with the longer sides facing toward the east and west.

The large structure which houses the wind tunnel is visible from the foothill communities to the south and west to only a limited extent due to haze and smog in the south San Francisco Bay area. On unusually clear days the building is a visually prominent structure in the distance. The structure is, however, in a cluster of very large structures between Bayshore Freeway and the salt ponds of the Bay, including three similarly large hangars at Moffett Field.

From a mid-range vantage point, the flat areas of the surrounding communities between the foothills and Bayshore Freeway, the existing wind tunnel facility is visible from only an occasional high point. The trees and the elevated freeway act as a visual buffer from mid-range.

From the Bayshore Freeway and the area north of the freeway, the immediate perspective, the wind tunnel (along with one of the large Navy hangars) is an imposing and very prominent structure (Fig. 6). Viewed from the residential and commercial area of Mountain View, north of Bayshore Freeway to the west, the building housing the wind tunnel is the largest element in that sector of the horizon. From Shoreline Park, also in Mountain View, located northwest of the Ames site, the structure is similarly prominent (Fig. 7). The building towers above the Naval housing located immediately adjacent to the facility to the southwest (Fig. 8). Moffett Field Naval Air Station, immediately east of the Ames site as noted earlier, has several large structures which tend to

Figure 6. VIEW OF WIND TUNNEL FROM BAYSHORE FREEWAY

Figure 7. VIEW FROM SHORELINE PARK

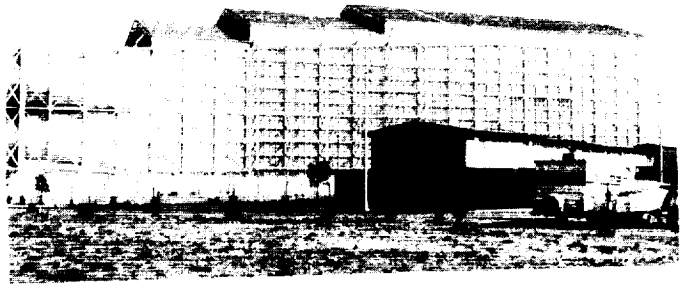


Figure 8. VIEW ADJACENT TO NAVAL HOUSING

diminish the visual importance of the wind tunnel structure both from Moffett Field and the communities beyond Moffett Field to the east.

The wind tunnel structure is only visible from communities in the East Bay on exceptionally clear days. On clear days the building is one of the largest elements visible on the edge of the South Bay.

2.11 Socioeconomics

Currently about 100 people at ARC are associated with the operation of the 40- x 80-foot wind tunnel, either working at the facility or performing other engineering planning, design, or analysis functions related to facility operation and maintenance. This represents about 3 percent of the Ames work force. If one assumes that the average salary of these individuals is about $17,000 per year, the direct contribution of the 40- x 80-foot wind tunnel to the Santa Clara County economic base (about 89 percent of Ames' employees reside in Santa Clara County) would be about 1.5 million dollars a year.

3.0

ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

3.0 ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

3.1 Introduction

Included in this chapter is a discussion of both the short- and long-term effects of the construction and operation of the proposed facility. Another aspect of the proposed action, i.e., the acquisition from the Navy of a small piece of property west of the old Moffett Boulevard and north of the newly realigned Moffett Boulevard will be discussed below. Although this land acquisition is a part of the proposed action, Ames plans to buy this land whether or not a new test leg is added, because the property is now physically separated from the existing Navy property by the newly realigned Moffett Boulevard.

3.2 Geologic Impacts

Construction of the proposed 40- x 80-foot wind tunnel extension would have little direct impact on the geologic environment. Some soil erosion could occur from the construction site where the soil is disturbed, but unless these construction activities occur during the rainy season and excavated material is piled near a storm drain inlet without any protection, the amount of eroded material entering the storm drain would be very minimal. Also, dust may be generated during grading and construction.

Most of the potential geologic hazards at the project site are common to all areas of the northern Santa Clara Valley -- southern San Francisco Bay Area. As with other sites located on deep, unconsolidated alluvial deposits in the seismically active Bay Area, the project site will be subjected to strong ground shaking during a large magnitude earthquake. However, as was stated in the discussion of geologic hazards (Section 2.2), what impact earthquake shaking will have on the proposed wind tunnel extension is dependent primarily on the design of the new structure. The potential hazards of liquefaction and expansive soils are more localized but are not expected to create any serious limitations to the construction and operation of the proposed project.

Although damage to the proposed structure due to conflicts with geologic hazards could have a serious financial impact for the Ames Research Center, it would not create any additional environmental problems.

3.3 Archaeology

There is no known archaeological feature that would be disturbed by the construction of the proposed project. However, a qualified professional archaeologist will be engaged to monitor ground breaking. Should cultural remains be discovered during construction, activity will be halted until qualified archaeologists have been given an opportunity to evaluate the situation.

3.4 Water

During the construction period, sediment will be generated from the site. Quality of runoff from the disturbed site during the construction period will be poorer than runoff from the existing site due to sediment load. However, such runoff will not have any impact on the beneficial uses of nearby water bodies because the storm runoff collects in a pond and is not discharged into the Bay by the existing storm-drainage system. Construction of the relocated Ames substation close to Stevens Creek may involve temporary discharge of small amounts of sediments and pollutants to the creek.

Even after the completion of the construction, some sediment production from the site should be expected. The exposed soil of the truck-farm operation is currently subject to a low degree of wind and water erosion. When ground contours are restored, the degree of erosion and sedimentation from the site will be slightly less than that at present.

The proposed underground fuel storage tank for test models at the site may be ruptured during severe earthquakes, which will release petroleum fuel underground and overground. Groundwater may be contaminated. The risk is equal to that of present facilities.

The new construction will add approximately 6 acres of impervious surface to the NASA facilities. It will produce slightly increased runoff volumes and an increase in the peak-flow rate of storm runoff. The existing storm-drain system can handle the flow volumes and peaks.

The NASA site is already developed to a great extent; hence the quality of runoff originating from the ARC is generally poor. Although storm runoff from the new facilities will increase the total pollutant load attributable to stormwater runoff, the quality of runoff from the

new site should be of better quality than that originating from the present NASA facilities. Because of this and the small size of the new facilities compared to the already existing development, the impact should be minimal. Secondly, runoff from the site is not discharged into the Bay and does not affect any useful source of water.

3.5 Air

Construction of a new facility always creates some local dust. This should not affect any receptors. Because standard construction practices will be followed, the effects will be small and short-lived.

Emission of pollutants from the wind tunnel are due almost entirely to the testing of models with running jet engines. Approximately two-thirds of all testing is performed on models that have running engines. The number and size of the engines may vary considerably. From one small jet engine to four jet engines with a combined thrust of 50,000 pounds is an example of this range.

The fuel consumption of a jet engine naturally varies greatly with its mode of operation. The emission rates of pollutants also very. The maximum emission of nitrogen oxides occurs during the full throttle or take-off mode of operation; during the idle the nitrogen oxide emissions drop off to low levels. Emissions of carbon monoxide and hydrocarbons act oppositely to those of nitrogen oxides. The maximum emission of these two pollutants occurs during idle. The emissions of particulates and sulfur oxides, and evaporation of jet fuel are very low for jet engines. Exhaust particles are relatively large in size and tend to settle out rapidly. They lead to more of a local soiling problem than to any decrease in visibility. The emission of sulfur oxides, similar to those from automobiles, is small. Evaporation of jet fuel is little since its vapor pressure is much lower than that of gasoline.

After modification, the combined running time of the two test sections will be less than the present running time of the 40- x 80-foot

test section, due to addition of energy-saving measures to minimize run time. Testing in the 40- x 80-foot section is expected to comprise 40 percent of future testing. The remaining 60 percent of testing will be done in the 80- x 120-foot test section.

The repowering will increase the versatility of the 40- x 80-foot section by offering a higher wind speed. Model engine size and pollutant output per test will remain unchanged. Since less testing will be performed in the 40- x 80-foot test section than at present, the section's emission output will drop in the future.

The operational procedure of the 80- x 120-foot test section will be preferable to that of present testing. The new section will be operated only in an open-circuit flow configuration. This will allow fresh air to constantly dilute emissions from model engines. When emissions exist they will be diluted several orders of magnitude below those which the present tunnel releases. This method of operation should ensure that microscale air quality degradation will be kept at a minimum level due to the new test section.

Calculations show that the emissions from operating engines in the new test section will add very small amounts of air pollutants to ambient air. Table 2 presents the incremental concentration increases that will be caused by operation of the facility and compares them with the strictest federal or state standard. From this table, it is evident that emissions from the 80- x 120-foot test section will not appreciably affect the local air quality environment. It should also be noted that emissions from the 40- x 80-foot wind tunnel, which have air pollutant concentrations several times higher than those shown in Table 2, have not been detected to cause the ambient air quality standard to be exceeded.

Fuel usage is a good indicator of the total amount of pollutants emitted by the tunnel's operation. Emission factors can be applied to

Table 2

PREDICTED EMISSION CONCENTRATION
AT EXHAUST DURING OPERATION OF
80- X 120-FOOT TEST SECTION

EMISSION	MAXIMUM TESTING	1-HOUR AMBIENT AIR QUALITY STANDARD	AVERAGE TESTING	ANNUAL AVERAGE AIR QUALITY STANDARD
CO	0.27 ppm	35.0 ppm	0.05 ppm	--
NO_2	0.01 ppm	0.25 ppm	0.003 ppm	0.05
SO_2	0.005 ppm	0.10 ppm	0.001 ppm	0.03
HC	0.1 ppm	0.24 ppm[a]	0.03 ppm	--
Particulates	9.3 $\mu g/m^3$	--	2.1 $\mu g/m^3$	--

Source: URS Research Company, 1975.

a - 3-hour standard.

Note: Wind speed assumed to be approximately 75 knots. Rates are based upon output of a JT-9D jet engine proportioned to expected fuel usage.

fuel data using the standard landing/take-off cycle. The resulting rate and totals are probably the most realistic emission figures available.

The present fuel usage of the tunnel is 40,000 gallons yearly. This amount is expected to increase and possibly double when the modified section is completely operational. The increase will be due to testing of larger models in the 80- x 120-foot test section.

The maximum daily fuel usage of the 40- x 80-foot tunnel is now near 1,000 gallons. This high usage occurs during testing of military fighters. Emission rates are shown in Table 3 and are based on the daily maximum fuel usage and annual levels.

An indication of the magnitude of these emissions can be gained by comparing future wind tunnel emissions to the total emissions from ARC and Santa Clara County. As can be seen in Table 4, future emissions from the wind tunnel will, depending on the air pollutant, range from 5 to 14 percent of the total emissions from ARC and 0.001 to 0.008 percent of the total emissions from Santa Clara County. If one assumes that there is a proportionate correlation between reactive hydrocarbon levels and photochemical oxidant concentrations, Table 4 indicates that future wind tunnel emissions will contribute about 0.001 percent to oxidant levels in Santa Clara County, an extremely negligible contribution.

The proposed exhaust system design calls for louvers and a deflector to direct the air leaving the approximately 130- x 290-foot exhaust section upward. The concrete floor of the intake section will eliminate any dust problems. Entrainment of dust or rain is not expected to be a factor of any significance.

Table 3

EMISSION OUTPUT RATE OF MODEL ENGINES
(Pounds)

	HOURLY AVERAGE		HOURLY MAXIMUM[c]		YEARLY TOTAL	
	PRESENT[a]	FUTURE[b]	PRESENT	FUTURE	PRESENT	FUTURE
Fuel Usage	60 gal	120 gal	243 gal	486 gal	40,000 gal	80,000 gal
Particulates	0.29	0.59	1.18	2.37	195	390
SO_2	0.41	0.83	1.66	3.32	270	540
CO	10.5	21.0	42.7	85.3	7,000	14,000
HC	2.7	5.5	11.1	22.2	1,800	3,600
NO_x	7.0	14.0	28.6	57.3	4,700	9,400

Source: URS Research Company, 1975.

a - Present refers to ongoing operations of the 40- x 80-foot test section.
b - Future refers to output of the two combined sections when the modified tunnel is fully operational. Basically a doubling of all present emissions is expected.
c - Maximum output will be expected during testing of large military type aircraft. The emissions of a single Jumbo Jet engine (JT-9D) closely approximate this level.

Note: All values are based upon EPA emission factors integrated over the standard landing/take-off cycle. The Pratt and Whitney JT-9D engine was used as a base.

Table 4

EMISSION RATE OF MODEL ENGINES IN THE MODIFIED WIND TUNNEL AS A PERCENTAGE OF ARC AND SANTA CLARA COUNTY

EMISSIONS ON AN ANNUAL BASIS

AIR POLLUTANT	FUTURE WIND TUNNEL EMISSIONS AS A PERCENTAGE OF EMISSIONS FROM: ARC	SANTA CLARA COUNTY
Carbon Monoxide	5	0.001
Nitrogen Oxides	12	0.008
Sulfur Oxides	14	0.008
Particulates	5	0.002
Total Hydrocarbons	9	0.001

Source: URS Research Company, 1975.

3.6 Biology

Present agricultural use of the site of the expanded wind tunnel has restricted wildlife to a few cosmopolitan species. Only these species will be affected by the enlarged wind tunnel, as the extent of their habitat will be reduced. The impact is minor, however.

Vegetation and wildlife of Stevens Creek and of the salt marsh should not be affected by either the construction or operation of the proposed facility. Construction activities should be confined to the area which is currently cultivated for agriculture. Operating impacts, i.e., noise, will be somewhat less intensive than previously. Wildlife is rarely excluded by noise. Although there may be an initial fear reaction, birds, rabbits, ground squirrels, and other fauna can be found in and around most airfields where vegetation provides appropriate habitat or where food is present.

3.7 Noise

Short-Term Impact

Noise levels from construction activities are normally annoying to residential areas because their residents do not adapt well to varying noise environments.

Tunnel construction activities can be divided into two phases: ground clearance and excavation activities, and tunnel erection and fabrication.

It is estimated that ground clearing and excavation (including pile driving) will take three months to complete. Grading, a major source of construction noise, typically generates average noise levels of 83 to 89 dBA measured 50 feet from the site, with peak noise levels of 95 to 100 dBA. Pile driving, another significant noise source, generates noise levels between 100 and 107 dBA at the source, depending on piston ram weight and stroke. With the exception of concrete trucks, truck traffic noise impact will be minimal because cut-and-fill will be small. Average distance between noisy activities and the nearest housing is 250 to 350 feet. Making allowances for attenuation with distance, average anticipated noise levels will range from 73 to 80 dBA, with occasional peaks as high as 90 dBA. These noise estimates are upper-bound estimates for their respective categories.

It is likely that grading and excavation activities will generate sufficient noise and ground vibration to disturb many of the residents in the housing units close to the construction site. With the exception of pile-driving noise, little noise impact is expected to occur at the trailer park.

The tunnel fabrication phase is estimated to take 18 months to complete. The main noise sources during this phase will be the movement of construction materials to the site by diesel truck and the erection of the metal structure and installation of the new power system. Some complaints from the Naval Dependent Housing should be anticipated from diesel truck traffic. The movement and construction of the exoskeleton probably will generate enough noise to disturb nearby residents. To a large extent this is mitigated by use of nuts and bolts or welded joints rather than the noisier steel rivets. Some complaints, however, will occur during this phase of construction.

The noise impact on the trailer park from tunnel fabrication probably will be minimal because attenuation of the noise with distance should cause the noise level from this source to be below that from Bayshore Freeway.

Long-Term Impacts

Long-term impacts are primarily concerned with the changes in the noise environment generated by the modified wind tunnel.

It is difficult to accurately predict the exact character of noise generated by the new wind tunnel. However, analytical studies by Robin M. Towne & Associates and by Bolt, Beranek, and Newman, and experimental model studies at Ames Research Center have been used to identify and predict the levels of major noise sources from the expanded wind tunnel. Using this information, approximate noise level contours were derived for possible noise-sensitive areas. Figure 9 illustrates these contours for the repowered 40 x 80 tunnel, and Figure 10 illustrates the contours for the non-return 80 x 120 test section. The predicted noise levels include 16 dBA of noise attenuation installed in both the tunnel inlet and exhaust to mitigate noise impacts.

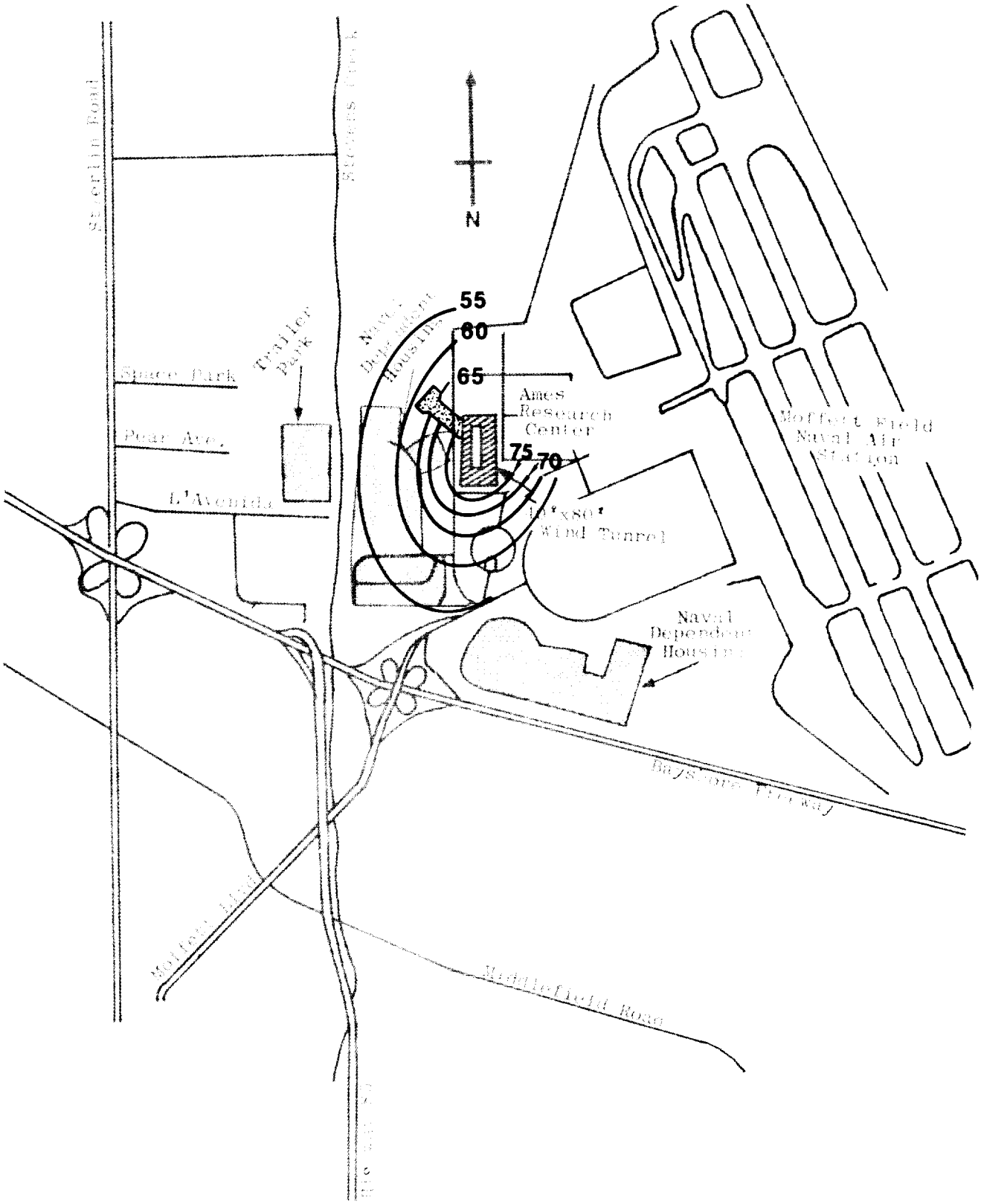


Figure 9. PREDICTED PEAK NOISE LEVELS AT MAXIMUM SPEED IN 40- x 80-FOOT TEST SECTION, dBA

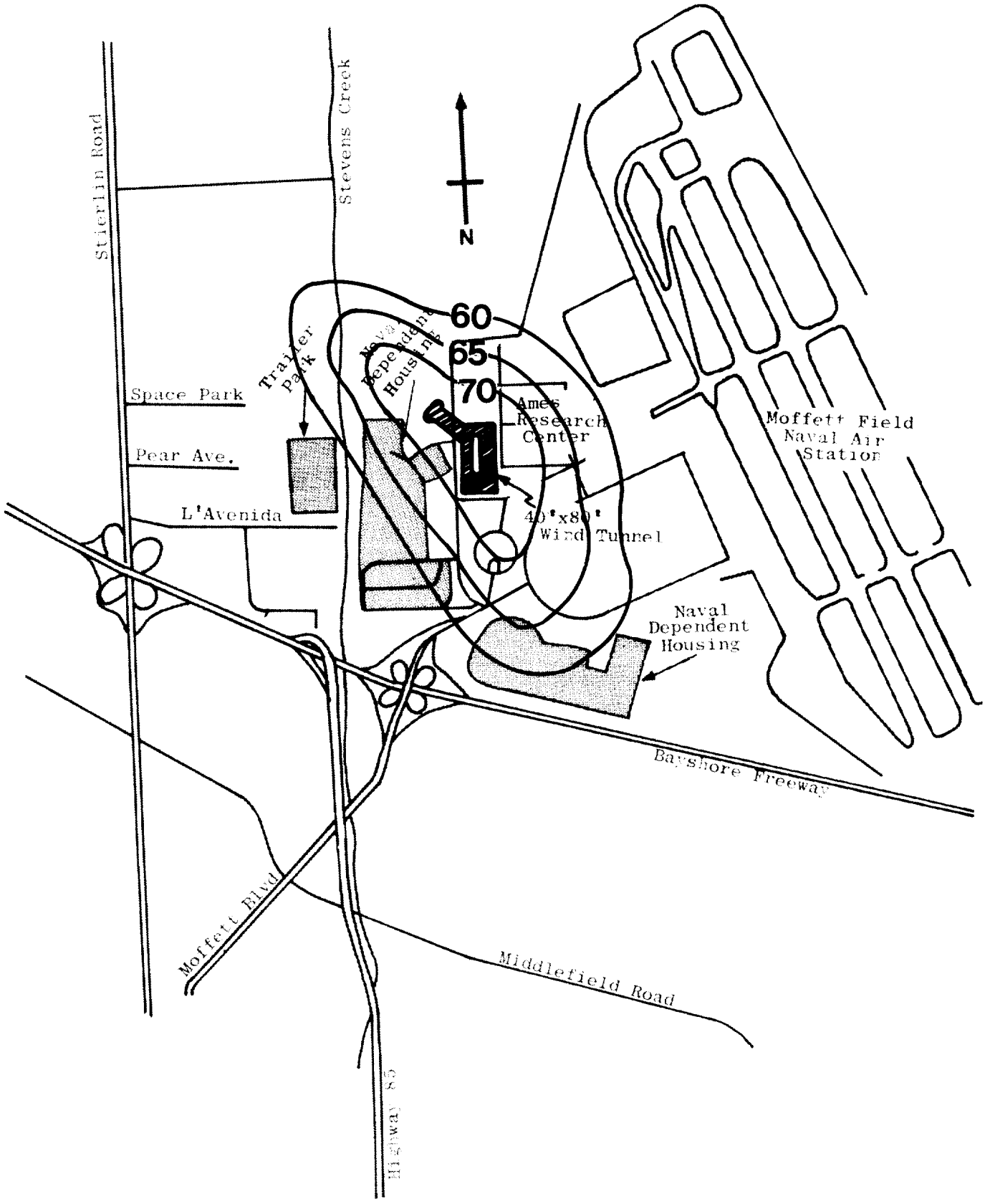


Figure 10. PREDICTED PEAK NOISE LEVELS AT MAXIMUM SPEED IN 80- x 120-FOOT TEST SECTION, dBA

These contours show the noise predicted for each tunnel test section operating at maximum speed.* The amount of time each tunnel test section would operate at maximum speed is shown in Table 5. Noise levels at lower test speeds are lower by an amount equal to 50 times the log of the ratio of maximum obtainable speed in that test section to the test speed. For example, if the modified 40 x 80 generates 68 to 70 dBA at some location when operating in the speed range of 280 to 300 knots/hour, at half that speed, noise levels would be 15 dBA lower or 53 to 55 dBA.

Another important consideration in determining the project changes in the noise environment is the duration of noise levels. The number of test days per year for the modified facility is not expected to change. Therefore, the decreased test hours will be accommodated by less hours of testing per day, on the average. This results in about 1.24 hours/test day, with 84 days of testing in the 40 x 80, and 124 days of testing in the 80 x 120. This compares with the average of 1.60 hours per test day for the existing facility.

Using the information presented in Figures 9 and 10 and Table 5, the change in noise environment was determined for the ten locations shown on Figure 11. Results are shown in Table 6.

In summary, the Naval housing west of Moffett Boulevard and near the tunnel will generally experience a decrease in noise and vibration. When the noise levels of this new noise environment are compared to the levels established by the Environmental Protection Agency to protect the public health and welfare with an adequate degree of safety, it can be seen that this new noise environment essentially eliminates activity interference as a cause for complaints. The conservative level that EPA has established for activity interference is a day-night average energy

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*An exception to this statement will be discussed later in the test.

Table 5

UTILIZATION OF PROPOSED FACILITY

TEST SECTION SPEED RANGES (knots)	TIME AT TEST SPEED FOR EACH TEST SECTION (Hours/Year)	
	40 x 80 TEST SECTION	80 x 120 TEST SECTION
0 - 30	BRIEF	10.30
30 - 40	3.09	10.30
40 - 50	3.09	10.30
50 - 60	3.09	10.30
60 - 70	3.09	10.30
70 - 80	3.09	10.30
80 - 90	3.09	10.30
90 - 100	3.09	10.30
100 - 110	3.09	72.07
110 - 120	3.09	0
120 - 140	6.18	0
140 - 160	6.18	0
160 - 180	6.18	0
180 - 200	6.18	0
200 - 220	6.18	0
220 - 240	6.18	0
240 - 260	6.18	0
260 - 280	6.18	0
280 - 300	25.73	0
TOTAL	102.98	154.47

Source: NASA-ARC, 1976.

Table 6

PROJECTED NOISE ENVIRONMENTS FOR SELECTED LOCATIONS

LOCATION	CURRENT					PROJECTED				CHANGE		
	AMBIENT 24-HOUR L_{eq} [a,b]	PEAK, dBA	TEST-DAY L_{eq} [c]	ANNUAL L_{eq} [d]	ANNUAL HOURS>AMB	PEAK, dBA	TEST-DAY L_{eq}	ANNUAL L_{eq}	ANNUAL HOURS>AMB	TEST-DAY L_{eq}	ANNUAL L_{eq}	ANNUAL HOURS>AMB
A	55	70	57 [e]	56 [e]	204	65	55 [e]	55 [e]	168	-2	-1	-36
B	55	75	60	59	241	70	56	56	204	-4	-3	-37
C	55	59	55	55	83	58	55	55	67	0	0	-16
D	55	≤Amb	55	55	0	≤Amb	55	55	0	0	0	0
E	54	≤Amb	54	54	0	≤Amb	54	54	0	0	0	0
F	56	57	56	56	56	57	56	56	57	0	0	+1
G	56	65	56	56	160	66	56	56	92	0	0	-68
H	55	65	56	55	166	66	56	55	92	0	0	-74
I	55	65	56	55	166	71	58	57	197	+2	+2	+31
J	65	65	65	65	0	69	65	65	105	0	0	+105

a - All L_{eq} are A-scale weighting of noise levels, energy averaged over 24 hours.

b- Ambient is defined as the noise environment without tunnel contribution.

c - Test-day L_{eq} is 24-hour energy-averaged noise level for typical test day.

d - Annual L_{eq} is 24-hour energy-averaged noise level for typical year with tunnel operating.

e - All values are rounded to nearest decibel.

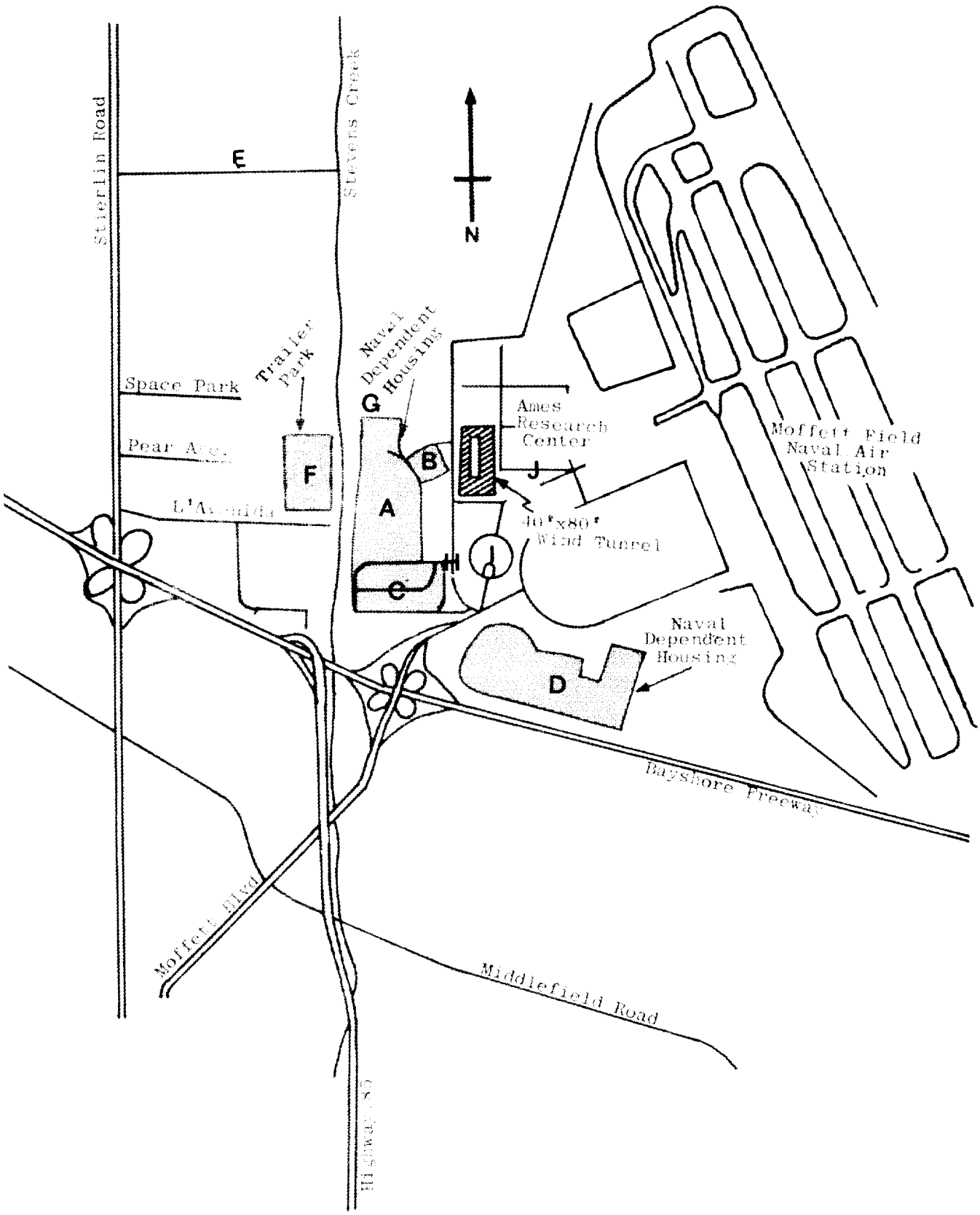

Figure 11. LOCATIONS ANALYZED FOR CHANGES IN NOISE ENVIRONMENT

level (L_{dn}) of 55 dBA* It should be noted that, for this noise source, both L_{eq} and L_{dn} values are assumed to be the same, as only limited operation activities occur between 10 and 12 p.m.

Generally the EPA criteria will be met. Other criteria are less stringent. For instance, noise criteria developed by the Department of Housing and Urban Development state that a normally acceptable noise environment is one where the 65-dBA level is not exceeded more than 8 hours per day. Correspondingly, the Department of Transportation has set forth a criteria of 70 dBA for the noise level not to be exceeded more than 10 percent of the time for outdoor areas near residences, schools, parks, playgrounds, etc. According to the EPA, a $L_{eq(24)}$ level equivalent to an L_{10} level of 70 dBA would be about 68 dBA; clearly, projected noise levels will not be reaching this limitation.

As shown in Table 6, there will be no change in the noise environment for the Naval housing southeast of the tunnel. Those units bordering Bayshore Freeway will continue to have an incompatible noise environment due to traffic noise. The Ames Research Center and Navy offices primarily north-northeast and south-southeast of the tunnel will generally experience increases in their noise environment. However, such increases are mitigated to some degree because of greater noise attenuation provided by these types of structures, and the fact that a large part of testing time in the wind tunnel will occur in the evening when offices are not occupied. Offices within the immediate vicinity of the tunnel exhaust, e.g., the library, would experience 75- to 80-dBA peak exterior noise levels. The library structure has been found to attenuate noise approximately 20 dBA; thus peak interior noise levels would range from 55 to 60 dBA.

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*U.S. Environmental Protection Agency, Information on the Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, Report No. 550/9-74-004, March 1974.

The provision of approximately 16 dBA of muffling for the 80 x 120 inlet and exhaust, and use of low-speed fans will eliminate adverse impacts south of Bayshore Freeway and west of Stevens Creek. The trailer park to the west of the tunnel will also not experience any increase due to this facility over its current ambient level. Tunnel noise may occasionally be audible in residential areas south of Bayshore Freeway under certain meteorological conditions.

The predicted noise levels of the facility are based on standard day conditions (29.92 in Hg, 59^{o} F) with no wind. Generally, both wind and vertical temperature gradients can have a large effect on sound propagation from any source. Typically the wind at Moffett Field comes from the NNW. The sound then could carry toward the SSE. A normal temperature gradient causes sound waves to bend upward while a temperature inversion causes sound waves to bend downward. The worst case, then, would be a NNW wind at the same time as a temperature inversion. In principle the wind tunnel noise could "skip" over large distances; i.e., noise levels near Ames could be low while noise levels miles to the SSE could be relatively unattenuated. However, generally at Ames the inversaion layer (when it occurs) is on the order of two thousand feet and the winds occur in the afternoon during commute hours when the freeway noise is high so that the effects of wind and inversion layer are not significant except for very rare occasions. Because of this, attempts to quantify the effects of wind and inversion layer have not been successful. In addition these effects are too little understood to predict quantitatively. The 40 x 80-Foot and 80 x 120-Foot wind tunnel noise is primarily low frequency and has a spectral shape very similar to that of the U.S. 101 freeway noise except for a tone at 90 Hz. At a few locations this tone may make the wind tunnel noise identifiable relative to the freeway noise.

It is anticipated that operating full-scale aircraft models will occasionally be tested in the modified wind tunnel. In some cases, these models will generate more noise than the tunnel itself and thus cause

higher noise levels than shown in Figures 9 and 10. Estimates of the frequency of occurrence of noise levels from models indicate noise levels would be as much as 10 dBA higher than shown in Figures 9 and 10; these levels will occur 15 to 20 percent of tunnel test time during the year. The highest projected noise levels would occur when operating models are tested in the 80 x 120 test section. These higher noise levels could occasionally cause annoyance to residential areas south of Bayshore Freeway.

Inasmuch as the modified facility will generally have less noise impact than the current 40- x 80-foot wind tunnel operation it is expected that effects of the modified facility operation combined with effects of the aircraft operations of Moffett Field Naval Air Station will be either the same or lessened.

3.8 Transportation

Modification of existing facilities and construction of new facilities are fairly constant activities at Ames Research Center. Although construction of this project would represent a slight increase against that background of activity, traffic impacts during construction are not expected to be significant. Delivery of heavy materials and components could be accomplished via the on-site rail spur maintained by the Navy and occasionally used by Ames.

As mentioned in the socioeconomics section, manpower needs for this facility will not increase above the levels presently required by the 40- x 80-foot section. Consequently, local traffic volumes will not be increased. In fact, average daily traffic will be somewhat reduced because of the closing of Moffett Boulevard, which has in the past provided limited public access to the bayshore and marsh area north of Ames land. As the usage for this purpose has been very low, the adverse impact will be minimal. It also should be noted that the road closure has already been completed for security reasons with the approval of both Santa Clara County and the City of Mountain View. Mitigation of this impact will eventually be accomplished by plans to develop the Mountain View, North Bayshore area roads. Extension of Terminal Boulevard southward, development of Stierlin Road for shore access, and rerouting of Moffett Boulevard to the Terminal extension would reestablish public access at a superior level.

3.9 Utilities

Electric Power

The proposed project has a two-phase impact upon the electric power system. Initially, construction efforts will require moving a portion of the Ames main substation to a new site, adjacent to Stevens Creek and west of the present site; in the second phase, the existing 40- x 80-foot wind tunnel will be modified. Neither of these two phases will result in increased electrical power consumption by the Center. In fact, the energy savings program now being implemented at Ames will result in reductions in overall Ames power demands; that is, the slight increase in power consumption due to the modified 40- x 80-foot wind tunnel will be more than offset by reductions in the electrical power demand of other facilities at ARC.

The proposed construction calls for the removal of PG&E circuit breakers and the Ames equipment from their present location to a new site nearby. Ames and PG&E equipment will continue to be served by 115-kv lines; some realignment of the towers will be required. A single set of towers will then carry an overhead 2-circuit 115-kv service to a new receiving structure at the existing Ames substation. No changes in the power or line voltage for the Ames substation are required for this project.

A new outdoor 100-MVA substation will be installed for repowering the main drive motors. The power will be supplied from the existing Ames substation; circuit breaker protection will be added. Operation of the repowering will be coordinated with the entire NASA/Ames facility so that the existing demand load will not be exceeded, as required by Ames contract with PG&E and the Bureau of Reclamation.

The existing 12-kv distribution line paralleling Moffett Boulevard will be rerouted by PG&E without any significant disruption of service. The underground electrical duct bank that feeds the 40- x 80-foot wind tunnel, even though routed under the new leg, will not be affected by the construction effort.

The technical load for the proposed modification will consist of six synchronous motors, driven by modified motor generator sets, with a maximum rating (for up to 2 hours) of 22,500 hp for each motor (18,000 hp continuous). This represents a maximum load of approximately 100,000 kva -- almost four times the original value. Since this approximately 100-mw load represents about 56 percent and 38 percent of the daytime and nighttime peak power demand limits respectively, the new facility must be carefully scheduled to remain within these limits. (If these limits were exceeded it would be unlikely to perturb the PG&E systems; however, it would be very costly to ARC because of the increased charges invoked by the utility.) Since the Unitary wind tunnel requires almost twice this amount of power, the present electrical system is more than adequate; only restrictions on scheduling, which is an internal problem, result.

The building load for the new test section will require the installation of a new 750-kva substation. This slight increase in load is unimportant overall. All equipment will be grounded as required by prevailing codes.

At this time (early in the design phase of the modifications), it would appear that the total testing time at the new facility will be less than it is today (the present 333 hours/year will be reduced to 257 hours/year). Although total testing time will be reduced, the addition of more powerful electrical motors will increase power consumption; based on the operating schedule mentioned previously in Section 2.7, the maximum energy use would be about 14,500 mw-hours per year.

This number represents about 6 percent of the total Center energy use. The utilities providing the power (PG&E and Bureau of Reclamation) produce, between them, about 70 million megawatt-hours of electrical energy per year; thus, the Center requires less than one-half of 1 percent of the energy produced by them. The energy required for the proposed modifications to the 40- x 80-foot wind tunnel would increase this number by about 0.02 percent, although it should be reiterated that the energy savings program at Ames will actually reduce total power consumption at the Center. It also should be noted that about 90 percent of the Center's power needs are supplied by Bureau of Reclamation power, which is produced at hydroelectric facilities. Therefore, power consumption at Ames due to wind tunnel demands has very little effect on air quality.

Water

Although the new leg will require some additional water outlets, overall usage is not expected to increase appreciably since operating manpower will not increase. Hence, the new construction will have no noticeable impact on water consumption.

However, the proposed leg may require the realignment of the Ames 18-inch water supply main. This realignment will take the main under a portion of the 80- x 120-foot section but will avoid foundation work. The 6-inch main serving the farm area will be abandoned.

The new section of the 18-inch line will be accomplished by the contractor and the switchover to this new section will be undertaken with the cooperation of the Ames water utility personnel at off-peak periods. Little or no interruption of service will occur in any section of the Ames facility, with most sections continuing to be supplied continuously by the 10-inch supply main and distributed through smaller looped lines.

One fire hydrant will be relocated.

Sanitary Sewer

Since the number of employees is not expected to increase, the building load will not increase appreciably. However, the construction phase will necessitate some minor realignment of a 15-inch line serving the Naval housing. This line will be carried under the new 80- x 120-foot leg and intercept the 27-inch line which also must be rerouted slightly. The switchover of the 15-inch line will be undertaken at off-peak hours and will necessitate little or no inconvenience to the residents of the Naval housing.

Other Utilities

The new construction will require extension of the existing utilities, primarily to the new control room. However, only Ames internal operations are affected and any increased consumption or demands on resources are minimal. The PT&T line paralleling Moffett Boulevard will no longer serve any function and will be abandoned.

3.10 Visual

The new test leg will extend out into the field adjacent to Stevens Creek at a 45^{o} angle from the existing 40- x 80-foot wind tunnel. The wind tunnel extension will be approximately 560 feet long, 150 feet high, and 120 feet wide, fanning out to a width of approximately 422 feet at the northwest end. The structure will look similar to the existing 40- x 80-foot wind tunnel in terms of the structural framework visible on the outside and the metallic grey color. There will be paved areas around the new test facility for model access, model preparation and parking for the wind tunnel control room. There will be a minimum of outside lighting, which will include conventional street lighting. The lighting is necessitated by the swing shift, working evenings but not through the night. Generally, the new test leg will be of similar size and bulk to the existing 40- x 80-foot wind tunnel structure.

From the mountains and foothill communities to the south and west, the new test leg will alter the view minimally. From this perspective, the bulk on the horizon will be increased but, as noted before, the wind tunnel structure is now only visible clearly on unusually clear days. From the East Bay, to the extent that the 40- by 80-foot wind tunnel is now visible, the addition will add little to the size of the existing facility.

The view from Naval housing, Orion Park, will be the most affected by the addition of the new test leg (Figs. 12 and 13). The housing will be bounded on two sides by 150-foot metal walls within several hundred feet of the houses. Some pine saplings have already been planted along the perimeter of the housing site. Undoubtedly, with the wind tunnel addition, they will feel these small pines will provide little visual barrier for some time. The Navy apparently, however, when constructing Orion Park, did not consider the 40- x 80-foot wind tunnel a sufficient deterrent to preclude developing the land as housing.

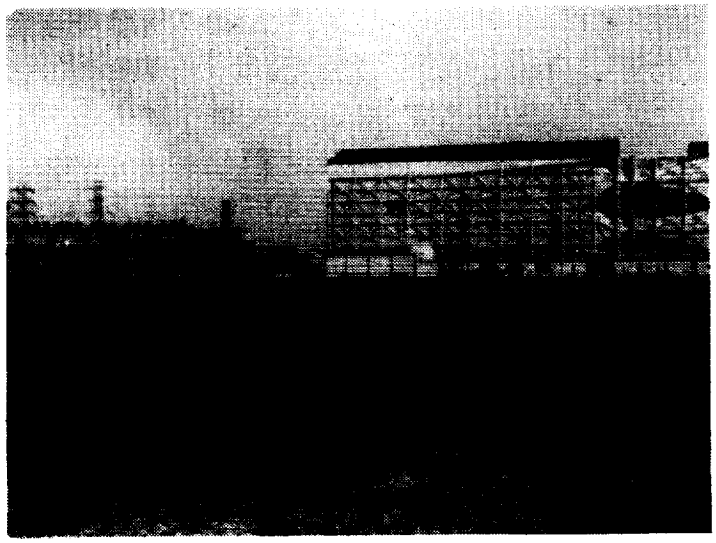

Figure 12. FROM NAVAL HOUSING LOOKING EAST (WHERE TEST LEG WILL COME OUT OF TUNNEL)

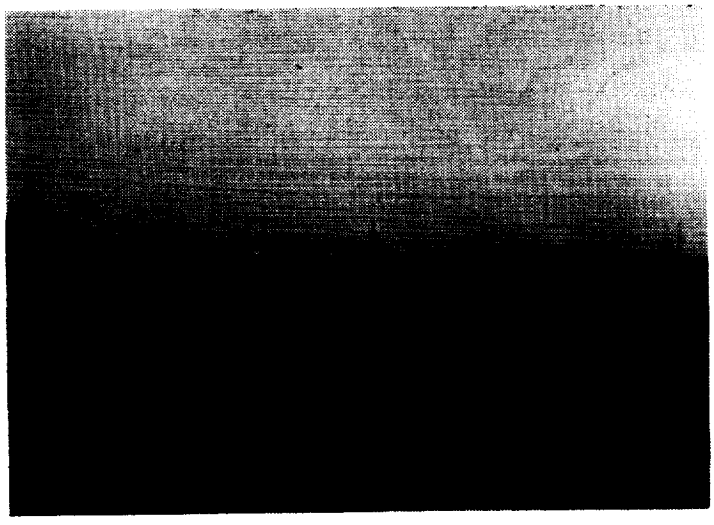

Figure 13. FROM NAVAL HOUSING LOOKING NORTH (NEW TEST LEG WILL EXTEND INTO PART OF THIS AREA)

Interviews with Naval housing personnel indicate that the Navy is not as concerned with the visual impact of the project as they are with the sound and vibration impacts.

From a mid-range perspective, the flat areas of the surrounding communities between the foothills and Bayshore Freeway, neither the existing wind tunnel facility nor the proposed addition will be visible except from occasional high points. The freeway and trees act as a visual buffer.

From the Bayshore Freeway and the area north of the freeway, the immediate perspective, the proposed structure will add substantially to the already considerable bulk of the 40- x 80-foot wind tunnel structure. The short-range view from the southwest will be the most heavily impacted, with the bulk approximately doubled. From the Shoreline Park in Mountain View, just across Stevens Creek, the new facility will be very prominent because the wind tunnel is several hundred yards closer to the park than the existing facility and the widest part of the structure is oriented toward the park. The view from Moffett Field and communities to the east will be virtually unaltered by the test leg addition.

3.11 Socioeconomic

Construction costs for the new facility will be about 80 million dollars. Because final design of the facility has not yet been completed, it is difficult to determine the amount of money that might be added to the local economy. Based on previous experience with projects of this sort, a substantial amount, probably about half of the total, of the materials and labor needed for construction activities will be obtained from local suppliers and contractors.

Operation of the new 80- x 120-foot test section in addition to reduced operation of the existing 40- x 80-foot test section is not expected to increase the number of employees above the 100 now required for the operation and maintenance of the existing 40- x 80-foot wind tunnel. Consequently, no significantly changed patterns of social or economic activity are expected to result from the operation of the new facility.

4.0

RELATIONSHIP OF THE PROPOSED FACILITY TO LAND-USE PLANS, POLICIES, AND CONTROLS

4.0 RELATIONSHIP OF THE PROPOSED FACILITY TO LAND-USE PLANS, POLICIES, AND CONTROLS

4.1 Introduction

This section identifies the effects of the project on local land-use patterns and community plans and goals. Information detailing the existing land-use patterns and community plans and goals can be found in the revised Institutional EIS.

4.2 Land-Use Impacts

Construction of the new test leg of the 40- x 80-foot wind tunnel will minimally alter land uses surrounding the Ames site. Farm buildings on ARC property, consisting of several sheet metal storage sheds and a small house used as a farm office by the farmer leasing the open area, will be eliminated to permit construction of the new facility and a small piece of property in the construction area wil be acquired from the Navy. PG&E's electrical substation will be relocated adjacent to Stevens Creek, west of its current location. As noted in Section 3.10, the new wind tunnel test leg will extend out approximately 560 feet at a 45^{o} angle from the existing wind tunnel facility. The fan-shaped northwest end of the new test leg will be approximately 650 feet from Stevens Creek.

Both the existing 40- x 80-foot wind tunnel and the proposed extension are land uses compatible with industrial, commercial, agricultural, and some recreational land uses. The new wind tunnel test facility is not, however, compatible with present non-conforming residential uses immediately adjacent to ARC. Naval housing, Orion Park, and Santiago Villa Mobile Homes Park, presently experience noise and vibration attributed to the 40- x 80-foot wind tunnel. These effects will be somewhat reduced after modification. (See Section 3.7 for a detailed analysis of these impacts.)

The new test leg is not expected to interfere with wildlife use of the marsh and salt pond areas of the Bay north to ARC, primarily because the noise levels anticipated will not significantly change current noise conditions as discussed in Section 3.7.

4.3 Impacts Upon Community Plans and Goals

The proposed action does not conflict with the broadly stated goals and policies of the Association of Bay Area Governments (ABAG). The ABAG Plan calls for infill of partially developed areas and expansion along the edges of existing communities; the ARC wind tunnel expansion adheres to both of these goals. The ABAG Plan map has the ARC site surrounded by basic employment* and open space land uses for the most part. Both of these uses are compatible with Ames' present and proposed uses.

The Ames proposed action is compatible with the goals and policies expressed in the Bay Conservation and Development Commission (BCDC) Plan. The project does not interfere with continued salt production in the salt ponds nor intrude on proposed wildlife refuge areas; it also furthers the concentration of noisy, bulky industrial land uses.

The proposed action is consistent with the goals expressed in the Policy Plan for the Baylands, prepared by the Santa Clara County Planning Department, as it does not interfere with wetlands preservation goals or pose a risk to life and/or property. The project does not, however, relate visually to the Bay as defined in the objectives for the use of the baylands. The plan suggests that priority be given to open space use over urban uses. While the ARC wind tunnel extension is clearly not an open space use, it is also not really new development nor will it be located in an area with open space characteristics presently. In the Urban Development/Open Space Plan also prepared by the Santa Clara County Planning Department, the ARC site is within the area designated for urban expansion, so the conclusion may be drawn that the project does not conflict with the goals and plans of Santa Clara County.

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*Basic employment involves agricultural and extractive activities. Basic employment as opposed to secondary (manufacturing) and tertiary (sales and retail) employment is concerned with the preparation of raw materials for manufacturing.

The City of Mountain View Planning Department is familiar with the proposed project and the long-range plans of ARC. The two agencies have cooperated in the planning of infrastructure (urban support services) common to Ames and the City of Mountain View. In addition, the Planning Department of the City of Mountain View has adapted their land-use plan for the North Bayshore area to assure compatibility with land uses at ARC. For instance, many of the residential uses north of the bayshore are to be eventually phased out "because of noise, flooding hazards, potential congestion and the great public costs which would be required to create a suitable residential environment;" however, the mobile home park and one small combination area (residential, industrial, and commercial) will be retained. The Plan suggests that displaced families will be rehoused in Mountain View in a more suitable residential environment. It is anticipated that a period of 20 to 30 years will be required to phase out residential uses other than the two mentioned.

Because of the extensive liaison between Ames and the City of Mountain View, as noted in the revised Institutional EIS, and the City of Mountain View's policy to restrict further residential development in the North Bayshore area, the proposed project will have little effect on the City of Mountain View's plans and policies. Although the construction and operation of the substation adjacent to Stevens Creek may have a visual effect upon the users of the park, the substation grounds will not encroach into the area that may be later designated as parkland.

5.0

ALTERNATIVES TO THE PROPOSED ACTION

5.0 ALTERNATIVES TO THE PROPOSED ACTION

The four main alternatives to the proposed project are: (1) variations of the siting of the proposed modifications; (2) other facilities which could be constructed at Ames Research Center; (3) other types of facilities which would be constructed elsewhere; (4) no project. Other wind tunnel concepts, such as pressurized wind tunnels with air as a working fluid, wind tunnels with polyatomic gases as working fluids, supercooled wind tunnels, etc., are not treated in this report because they do not provide the same capabilities for full-scale model testing.

5.1 Description of the Alternatives

Siting Alternatives

There are three other possible placements of the 80- x 120-foot test leg which have been investigated. They are:

- 80- x 120-foot test leg at the north end of the tunnel and tied in at a 45° angle. In this orientation, which is similar to the preferred project previously discussed in the main body of the report, the test leg would be attached to the very north end of the existing 40- x 80-foot tunnel, instead of being offset from the north end as in the preferred project. Because of this placement, the Ames substation as well as the PG&E substation would have to be removed. The removal of the Ames substation is particularly important, because it is the master station for underground supply to the Ames electric power network and, as such, its relocation would cause a lengthy shutdown of Ames Research Center (about 6 months). Of course, it would be possible to build a completely new substation that would tie-in to the underground network to reduce the amount of downtime required (under these conditions, the amount of downtime would be similar to that expected for the preferred project). However, the construction of a completely new substation to reduce downtime was rejected because of its excessive costs; it would require the purchase of new electrical equipment rather

than relocation of existing equipment and the construction of an extensive new underground power system to tie into the existing underground network.

- 80- x 120-foot test leg due north. This test leg orientation would require the removal of both the PG&E and Ames substations, as well as a number of other facilities. As in the above alternative, the expected downtime, if a completely new substation is not built, would be about 6 months. Because of the excessive costs of a completely new substation and the fact that the down-time reduction due to its construction would be limited, the construction of a new substation was rejected; hence, the selection of this alternative would have an unacceptable effect on Ames operations.

- 80- x 120-foot test leg due west. This test leg orientation would place the test leg in the midst of the existing Naval dependent housing, requiring relocation of those displaced to another area.

Other Facilities at Ames

Major alternatives of this type are:

- Repowering of the 40- x 80-foot wind tunnel without the addition of the 80- x 120-foot test leg. Newer and larger electrically powered motors would be necessary to increase the current wind velocities in the existing wind tunnel. However, this alternative does not meet all project requirements, and consequently would lead to the phasing alternative below.

- Phasing the implementation of the proposed project. The existing facility would be repowered, and the new test leg added at a later date.

- New wind tunnel. A new full-scale wind tunnel, providing two test sections of 40 x 80 feet and 80 x 120 feet, would be constructed. This facility would be northwest of the present 40- x 80-foot wind tunnel and parallel to Stevens Creek. Such a facility would operate in conjunction with the present 40- x 80-foot wind tunnel, providing maximum air speeds of 110 to 300 knots, respectively, in the two test sections.

- Adding the new test leg without repowering. The new test leg would be built but newer and larger electrically powered motors would not be installed. However, this alternative does not meet all project requirements. A phasing alternative is not considered below because the performance of the new wind tunnel without repowering is not adequate and hence would provide no new benefits.

- Construction of a new, larger tunnel. This project would be constructed in place of the new wind tunnel described above but would be considerably larger, having a 75- x 150-foot test section and a 133- x 200-foot test section. This alternative would provide capabilities greater than can currently be justified, however, they may be needed in the future.

Other Facilities Elsewhere

Major alternatives of this type are:

- Flight testing. Rather than conduct wind tunnel tests of aerodynamic characteristics of full-scale hardware, inflight testing would be carried out. Operational prototype aircraft and hardware would be flown from new or existing airports. Owing to the safety problem which would be encountered, Moffett Field and other military and civilian airports in urbanized areas would not be used; remote locations would be required. Also, development cost is greater to produce full-scale flying prototype aircraft than to produce testing models.

- New wind tunnel. This alternative provides the same facilities as previously discussed, only in a different location.

No Project

Since this site is owned by ARC, it seems inevitable that they will wish to utilize the property at some time in the future. At that time, questions of impacts would again arise. Therefore, the no-project alternative, even though it avoids the project impacts, would simply delay, not eliminate, wind tunnel impacts, as the need for a test facility would remain unresolved.

5.2 Effects of the Alternatives to the Proposed Action

The environmental impacts of the alternatives to the proposed action need some clarification before the relative merits or demerits of each can be determined. This section deals with how these effects differ from the proposed project.

Siting Alternatives

- 80- x 120-foot test leg due north. Except for noise and utilities, the environmental impact would not change. The noise impacts on Naval housing west of the tunnel will diminish because the inlet will be farther from noise-sensitive areas. However, noise impacts on Ames facilities north and east of the tunnel would increase. Siting of other new ARC facilities on vacant land north of the tunnel would be restricted by the noise environment. Utility impacts will be much greater because of the need to relocate both the Ames and PG&E substations and the increase in overall Ames downtime.

- 80- x 120-foot test leg due west. The impacts that will change are noise and utilities. Since the inlet is closer to residential areas, the noise impact will be greater. Noise impacts on current and planned land uses for lands within the city of Mountain View would be greatly increased, and the possibility of disturbance to residential areas south of Bayshore Freeway would also be increased. However, the impact on the utilities would lessen because the test leg does not interfere with present substation location.

- 80- x 120-foot test leg at the north end of the tunnel and tied-in at a 45° angle. The effects of this orientation would be similar to the preferred project in all areas except utilities; utility impacts would be much greater and would cause greater construction costs and Ames downtime.

Other Facilities at Ames

- Repowering the 40- x 80-foot wind tunnel without the addition of the 80- x 120-foot test leg. Soil, archaeology, water, air, visual, and land-use environmental impacts will be lessened because an additional structure would not be built.

Noise impacts would be reduced without the open inlet and exhaust of the new test leg which are significant noise sources. However, the repowered tunnel could not provide the capabilities of the 80- x 120-foot test leg.

- Phasing of project implementation. Repowering the 40- x 80-foot wind tunnel and deferring the construction of the 80- x 120-foot test leg would have essentially the same impacts as the proposed project. Deferral for several years would only defer some impacts, but some impacts, principally noise, may be increased due to the possibility of the development of adjacent vacant lands in the city of Mountain View to incompatible uses.

- New wind tunnel. Environmental impacts on soil, archaeology, water, air, visual, and land use would be greater than the proposed project, because a new structure at a different location would be needed. Impact on utilities would lessen because the substation would not be relocated. Noise impacts would also be lessened because of greater distance to noise-sensitive areas.

- Adding the new test leg without repowering. This alternative would not change the project impacts, except for noise; without repowering noise levels would be about 5 dB higher than the levels expected for the repowered facility. However, this alternative does not meet the goals of the proposed project.

- Construction of a new, larger tunnel. The impacts discussed above for a new tunnel apply here also.

Other Facilities Elsewhere

- Flight testing. Soil, archaeology, water, noise, utilities, visual, and land-use impacts will lessen because an additional structure would not be built. However, if a new airport would be required for testing, all the above impacts could occur elsewhere. Fuel consumption would be greatly increased by the very nature of this alternative, and because of increased transport of personnel, equipment, and supplies.

- New tunnel. It is difficult to ascertain the environmental impact of this alternative, because no site location has been proposed. However, the type of impacts for a new tunnel, as discussed in the preceding section, should be valid here. The determination of the magnitude of the impacts would require a site-specific analysis.

No Project

This alternative would not change the existing physical characteristics of the site. The most likely consequence of no-project to meet the needs of prototype testing would be the hindrance of research and development of technology, resulting in continuance of current but diffuse environmental consequences.

5.3 Conclusion

The proposed project has been selected as the most reasonable and prudent course of action in terms of meeting testing requirements, environmental consequences, cost, and disruption of ongoing activities at Ames Research Center.

6.0

ANY PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

6.0 ANY PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Implementation of the proposed project will generally cause a decrease in the noise environment in the surrounding area. Some present land uses of nearby areas are already inconsistent with noise levels generated by Ames Research Center (ARC), Moffett Field, and Bayshore Freeway. Despite this fact, ARC has used the design philosophy of decreasing where possible the current noise levels and has made provisions to mitigate the noise impact by installation of quieter motors and fans and the installation of a muffler system on the tunnel inlet and exhaust system -- both at major cost to the government.

The larger and more powerful drives will be quieter because Ames and several design study contractors have carefully minimized the noise-generating parameters of drive-fan operation, i.e., tip speed, in-flow distortion and turbulence, fan-stator spacing, and number of rotor and stator blades. The effectiveness of this design effort can be judged by the fact that projected noise levels from the repowered 40- x 80-foot wind tunnel will be approximately 5 dB lower than the existing tunnel, while at the same time the maximum wind speed in the 40- x 80-foot test section will be increased from 200 to 300 knots.

The capabilities of the wind tunnel also include its ability to measure model and prototype noise levels. This is an important factor in designing quieter aircraft. Thus, reduction of drive-system noise is important also from the testing standpoint.

The City of Mountain View is currently planning a regional park near the wind tunnel. The proposed wind tunnel expansion could affect this plan visually, because current project plans do not include adequate visual buffers around the proposed wind tunnel.

7.0

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.0 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENCHANCEMENT OF LONG-TERM PRODUCTIVITY

The construction of the proposed facility will bring about a long-term commitment of the facility site for this use. This commitment is not made at the expense of any other option, however. The land use proposed is recognized as being appropriate by all cognizant planning agencies (see Section 4). The modifications of the 40- x 80-foot wind tunnel will expand national aerodynamic testing capability. The major use of the modified facility for fixed-wing aircraft will be to improve the landing and take-off characteristics of the aircraft. Improved terminal area performance will provide for reduced air traffic congestion in short-haul systems and consequent savings in fuel. Wind tunnel testing of rotor aircraft will minimize risks encountered with developing new quieter VTOL types. In addition to reducing the noise level of the wind tunnel itself, the modified facility will permit acoustic research on aircraft systems that will help alleviate the noise problems around airports. These long-term benefits are discussed more fully in section 9.0.

8.0

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

8.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The proposed project conforms generally with the land-use plans recorded by the planning agencies involved. The relocation of the PG&E substation to a site nearer to the creek will have a minimal visual effect on the corridor park along the creek proposed by the City of Mountain View. The visual continuity of this proposed park, though, is already diminished by existing Naval Dependent Housing abutting the creek. Visual impacts of the new test leg, however, extend off-site and may impair the attractiveness of the nearby areas for which open space uses are planned.

Until the modification is completed (about 1979), energy use will remain at essentially the same level. Following completion, energy use would be increased because of the increased power requirements of the motors. The energy use of the modified facility would be about 16,400 megawatt-hours (mwh) per year.

This number represents about 6 percent of the present total Center energy use. The utilities providing the power (PG&E and Bureau of Reclamation) produce, between them, about 70 million mwh of electrical energy per year; thus, the Center requires less than one-half of 1 percent of the energy produced by them. The energy required for the proposed modifications to the 40- by 80-foot wind tunnel would increase this number by about 0.02 percent. However, it should be noted that because the electrical power consumption of other facilities at Ames will be reduced (an outgrowth of the energy savings program at Ames), total energy use at Ames will actually decrease in the future.

As the objectives of the proposed facility are intended to assist in the development of quieter and/or more efficient aircraft and engines, the concomitant improvements in fuel efficiencies will more than offset the "investment" in electrical energy resources. It also should be noted that about 90 percent of Ames' power is purchased from the Bureau of Reclamation. This is important because the Bureau produces all of its power from hydroelectric facilities, without the attendant increase in air pollution normally associated with electric power generation.

9.0

OTHER CONSIDERATIONS OF FEDERAL POLICY WHICH OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED FACILITY

9.0 OTHER CONSIDERATIONS OF FEDERAL POLICY WHICH OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED FACILITY

The modifications of the 40- x 80-foot wind tunnel will expand national aerodynamic testing capacity. Use of the facility for full-scale testing of aircraft systems under simulated flight conditions provides the opportunity to evaluate the operating efficiency, fuel consumption, safety of untested systems, and noise characteristics of airflow and engines prior to the construction of costly, fully operational aircraft. The size of the existing test facility allows testing full-scale models and hardware, thus allowing maximum accuracy in identifying performance characteristics of flight vehicles. In order to provide the same testing efficiency for large aircraft now being designed, larger test facilities are now required.

The major use of the modified facility for fixed-wing aircraft will be to improve the landing and take-off characteristics of these aircraft. Of special interest here is the need for research on short-haul systems that relieve air traffic congestion. Congestion around major air terminals cost the airlines nearly $160,000,000 in 1969. This congestion can be reduced by using aircraft with reduced landing and take-off distances. Such aircraft would reduce congestion by using auxiliary runways at major airports, using additional airports (thereby unloading the major airports, which are the source of most of the congestion), and keeping the short-haul traffic out of the airspace used by the conventional aircraft.

The potential fuel savings from eliminating time lost in terminal areas are considerable. For example, fuel wasted due to air traffic between Washington, D.C., and New York City is about 3,000 pounds per flight during congested periods. Use of a short-field transport operating

to small, satellite airfields would recover 2,630 pounds. During 1972, 205 one-way airline trips per day serviced these two cities. If half of these flights were during congested time periods, the fuel savings would have amounted to 16,800,000 gallons. In a typical generating plant, this fuel savings would be about 156,000 megawatt-hours (mwh) of electrical energy per year, which is several times the estimated energy requirement of 16,400 mwh per year for the modified 40- by 80-foot wind tunnel. Similar savings could be realized at other airports, such as O'Hare, where air traffic is congested. Relief of air congestion by short-field aircraft would also reduce fuel wastage by conventional aircraft operating from these airports.

Aside from the advantages of new and separate short-haul aircraft systems, modest improvements in aerodynamics can provide sizable benefits. For example, a 10-percent increase in maximum lift for a take-off-limited aircraft can reduce weight approximately 4-1/2 percent through slightly smaller engines and airframes. This modest weight reduction realizes a savings in direct operating cost of $222,000 per year for one aircraft, and with a fleet of 300 airplanes, the savings become $66,500,000. The savings on initial aircraft cost would also be considerable. If the selling cost is $7,000,000 per aircraft, the cost reduction for 300 aircraft would amount to about $94,000,000. Fuel savings by this weight reduction are also significant. Airframes are designed for a 30,000-hour life. Over this time period, fuel saved for one aircraft is about 2.4 million gallons, and, for a 300 aircraft fleet, the savings are about 720 million gallons (16.4 million barrels).

Errors in the prediction of full-scale behavior can lead to catastrophic aircraft failures. Full-scale wind tunnel testing is an effective way of minimizing this risk. The XV-3 and AH-56A were put directly into flight tests without the benefit of full-scale wind tunnel tests. Both aircraft encountered catastrophic failures resulting in

loss of the aircraft. The XV-1, XH-51, and XV-5A were tested in the 40- x 80-foot wind tunnel and encountered failures that could have been catastrophic in flight. All of these failures involved the complicated interface between aerodynamics, dynamics, and structures. Therefore, these problems could have been discovered only through tests of the full-scale hardware. For example, during the wind tunnel tests, the XV-1 compound helicopter encountered a rotor speed instability that required changes to the rotor control system. Tests of the XV-3 in the 40- x 80-foot wind tunnel were requested after catastrophic rotor-pylon whirl instability was encountered in flight, resulting in loss of the aircraft and serious injury to the pilot. After two tests in the 40- x 80-foot wind tunnel, separated by one year of analysis, this stability problem was alleviated so that a highly successful flight research program could be completed. As a result, the tilt-rotor aircraft is considered today to be one of the more promising high-performance rotary-wing aircraft concepts.

Some of the problems that lead to engine performance degradation also lead to changes in noise level. For an externally blown STOL (Short Take-off and Landing) configuration, the inlet lip flow angles can cause flow separation at the inlet lip, which causes an unsteady velocity distortion at the compressor face and increased fan noise, sources of noise that must be studied in a wind tunnel. For a lift-fan VTOL (Vertical Take-off and Landing) transport aircraft, inflow distortion can become a major noise source. Inflow turbulence and the increase in jet noise issuing perpendicular to the free-stream must be accounted for and minimized using full-scale wind tunnel studies.

Acoustic measurements of noise emanating from operating aircraft and engines have customarily been taken on static test stands with the implicit assumption that air speed does not affect the source. This assumption is, in fact, incorrect. Forward speed can introduce new noise sources, modify existing sources measured statically, and change

the location of the source. For these reasons, acoustics research in wind tunnels has become increasingly important.

For several applications, then, the research contributions of the proposed facility with its capability to test larger aircraft in the 80- x 120-foot test section, and a higher wind speed capability in the existing 40- x 80-foot test section will offset any adverse impacts of the facility, notably in the areas of increased efficiency of energy utilization and noise control.

10.0

COMMENTS RECEIVED ON THE DRAFT STATEMENT AND RESPONSES

10.0 COMMENTS RECEIVED ON THE DRAFT STATEMENT AND RESPONSES

10.1 Request for Comments

The Draft Institutional Environmental Impact Statement was submitted to the Council on Environmental Quality in November 1976. Notice of the availability of the Draft Statement was filed in the Federal Register at that time. Copies of the Draft Statement were sent to the following parties along with a solicitation of their comments:

Regional Administrator IX
U.S. Environmental Protection Agency

Office of Federal Activities
U.S. Environmental Protection Agency

Moffett Field Naval Air Station

Department of the Navy

Environmental Project Review
Department of the Interior

Office of Architectural and Environmental Preservation
Advisory Council on Historic Preservation

Advisory Council on Historic Preservation

Office of Environmental Affairs
Department of Health, Education and Welfare

Office of Environmental Quality
Department of Housing and Urban Development

Office of Environmental Quality
Department of Transportation

California State Water Resources Control Board

California State Department of Fish and Game, Region III

California State Lands Commission

California State Department of Public Health

California State Air Resources Board

California State Historic Preservation Office
Resource Management and Protection Division
Department of Parks and Recreation

California State Department of Transportation

California State Office of Planning and Research

California Regional Water Quality Control Board
San Francisco Bay Region

San Francisco Bay Conservation and Development Commission

Association of Bay Area Governments

Bay Area Air Pollution Control Board

Santa Clara Valley Water District

Santa Clara County Board of Supervisors

Santa Clara County Planning Commission

City of Palo Alto

City of Mountain View

City of Sunnyvale

City of Menlo Park

10.2 Comments Received and Responses

Comments on the draft statement were received from the parties listed below. A copy of each party's comments followed by the respective response is presented on the pages shown.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
100 CALIFORNIA STREET
SAN FRANCISCO, CALIFORNIA 94111

D-NAS-K12003-CA

Dr. Lewis Hughes, Chief
Health and Safety Office
Ames Research Center
Moffett Field CA 94035

Dear Dr. Hughes:

The Environmental Protection Agency has received and reviewed the draft environmental statement for the Modification of 40 X 80-foot Subsonic Wind Tunnel, Ames Research Center, Moffett Field, California.

EPA's comments on the draft environmental statement have been classified as Category LO-2. Definitions of the categories are provided on the enclosure. The classification and the date of EPA's comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions under Section 309 of the Clean Air Act. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and the adequacy of the environmental statement.

EPA appreciates the opportunity to comment on this draft environmental statement and requests one copy of the final environmental statement when available.

Sincerely,

Paul De Falco, Jr.
Regional Administrator

Enclosure

cc: Council on Environmental Quality

Air Comments

This DEIS amendment contains a number of deficiencies with respect to air quality. Perhaps anticipating such a comment, the amendment refers to an earlier, more detailed document, the "Institutional Environmental Impact Statement For the Ames Research Center". However, EPA has previously reviewed that document and pointed out air quality deficiencies to the Ames Research Center in a letter dated September 21, 1976. Those deficiencies concern baseline air quality data, emission data, modeling technique, overall air quality impact, and coordination with the AQMP process.

In spite of these deficiencies, EPA does not anticipate significant adverse impact on air quality as a result of this wind tunnel project. However, regarding future projects we suggest that the Ames Research Center respond to our comments of September 21, 1976 prior to proposing any project which has a potential air quality impact.

Noise Comments

The noise discussion should specify what meteorological conditions were used in the analysis. The history of complaints to NASA/Ames includes some from residents at considerable distance to the west of the facility. While these complaints have not necessarily been substantiated by proof that NASA/Ames sources were involved, care should be taken to examine worst case meteorological conditions (e.g., east winds and appropriate lapse rate).

The spectral character of wind tunnels should be discussed and in particular the extent to which the new source may differ in spectrum (hence audibility) from the other background sources (e.g., U.S. 101, Route 85).

Environmental Impact of the Action

LO--Lack of Objections

EPA has no objection to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER--Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to reassess these aspects.

EU--Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

Adequacy of the Impact Statement

Category 1--Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2--Insufficient Information

EPA believes that the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3--Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement.

If a draft impact statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

U.S. Environmental Protection Agency
Region IX, San Francisco

Comment:

It was suggested that the Draft Statement contained a number of deficiencies with respect to air quality and depended on reference to the "Institutional Environmental Impact Statement for the Ames Research Center." It was suggested that regarding future projects Ames Research Center respond to their comments of September 21, 1976 about the "Institutional Environmental Impact Statement for the Ames Research Center."

Response: The final "Institutional Environmental Impact Statement for the Ames Research Center," issued June 1977, has been revised to respond to the comments.

Comment:

It was suggested that the meteorological conditions used in the noise analysis should be specified.

Response: The text has been modified to indicate that standard day conditions were used in the noise analysis (Page 58).

Comment:

It was suggested that worst case meteorological conditions should be examined.

Response: The text has been modified to include a discussion of the effects of wind and temperature inversion (Page 58). However, as noted in the text, these effects are too little understood to predict quantitatively.

Comment:

It was suggested that the spectral character of wind tunnels should be discussed and the extent to which the new source may differ in spectrum from background sources.

Response: The text has been modified to include a discussion of the spectral character of the 40 x 80-Foot and 80 x 120-Foot wind tunnels only (Page 58). At a few locations a 90 Hz tone may make the wind tunnel noise identifiable relative to the background freeway noise.

DEPARTMENT OF THE NAVY
NAVAL AIR STATION
MOFFETT FIELD, CALIFORNIA 94035

Dr. Hans Mark
National Aeronautics and Space Administration
Ames Research Center
Moffett Field, California 94035

Dear ~~Dr. Mark:~~ Hans

This letter is in response to your letter of 23 December 1976 which discussed alternative methods of mitigating the adverse noise impact of the proposed addition to the 40 X 80 Foot Subsonic Wind Tunnel, and is the official Naval Air Station response to the Draft Environmental Impact Statement published as amendment No. 1 to the Institutional EIS for the Ames Research Center.

Your letter correctly identifies noise impact as the substantive issue raised during the meeting of 6 December 1976 during which the Wind Tunnel expansion project was presented to the Naval Air Station. It should, however, be noted that a number of other issues were raised and should be addressed in the Final EIS.

With respect to Air Field Safety clearances, the proposed addition will extend to an approximate elevation of 171 feet which penetrates the inner horizontal surface. The relationship of the structure to the runway elevation must be precisely determined. A waiver of airfield safety criteria may be required. Likewise, the height and location of the relocated PG&E substation and transmission line towers may require review with respect to airfield criteria.

The effectiveness of the exhaust deflector is a concern both from the accoustic view point, and as a source of possible visual pollution.

The discussion of air pollution on Page 40 of the Draft EIS is misleading. The third paragraph on that page could be interpreted to indicate that pollution from a jet engine and a car engine can be compared on a one for one basis. The impact will likely be much greater than indicated. The character of jet engine exhaust particles and the stationary nature of the source would seem to imply a high concentration of air pollution in areas close to the Wind Tunnel. The air pollution contribution might be considered by occupants of affected areas to be much greater than the "extremely negligible" description found on Page 43, paragraph 3, last sentence.

18:HLD:wc

Subj: Subsonic Wind Tunnel

The estimate of traffic generated by construction activity would appear to be understated on page 57. The prior construction of the proposed new bridge over Stevens Creek may be necessary to mitigate the impact of two way construction traffic upon the housing areas adjacent to Moffett Blvd.

With respect to the noise impact and the mitigative alternatives discussed in your 26 December 1976 letter, the Naval Air Station appreciates the thought that has gone into the alternative actions; however, there may be the additional need to provide some form of accoustic protection at some of the affected Naval Air Station buildings. Any alternative which addresses the scheduling of High Power Operations should involve more than a "sensitivity" to the problem but should involve a commitment to avoid the adverse operating noise during sleeping hours.

I regret that these comments were delayed in being transmitted to you; however, the recent fire which affected my Public Works Office contributed greatly to the delay.

Sincerely yours,

B. J. ADAMS
Capt, USN
Commanding Officer

Copy to:
COMPATWINGSPAC
WESTNAVFACENGCOM

Naval Air Station
Moffett Field, California

Comment:

It was suggested that the proposed 80 x 120-Foot Test Leg would penetrate the inner horizontal surface for Air Field Safety clearances and that proposed relocation of transmission line towers may also require review.

Response: Ames Research Center will conform to appropriate Air Field Safety Criteria in the review and approvals of construction which may penetrate control surfaces.

Comment:

It was suggested that the exhaust deflector is a concern both from the acoustic view point, and as a source of possible visual solution.

Response: The only acoustic effect of the exhaust deflector will be to shield nearby areas. The deflector will have no discernable visual impact on other than Ames employees working on the other side of the street.

Comment:

It was suggested that the discussion of air pollution on Page 40 of the Draft EIS could be interpreted to indicate that pollution from a jet engine and a car engine can be compared on a one for one basis.

Response: The text has been modified to eliminate that interpretation. (Page 42)

Comment:

It was suggested the character of jet engine exhaust and the stationary nature of the source would seem to imply a high concentration of air pollution in areas close to the wind tunnel.

Response: Thirty years of operation have not shown this to be the case. As noted in the EIS, the levels of air pollution are low and well within the strictest State or Federal standards, and because of the change in mode of operation, the concentrations will be even lower in the modified facility than they are at present. (Page 43)

Comment:

It was suggested that traffic generated by construction activity would appear to be understated in the draft EIS, and that prior construction of a new bridge over Stevens Creek may be necessary to mitigate the impact of construction traffic upon the Naval housing areas adjacent to Moffett Boulevard.

Response: As noted in the EIS (Page 59), Modification of existing facilities and construction of new facilities are fairly constant activities at Ames Research Center. The construction of this project is expected to spread over four years and would represent a slight increase against this background of construction activity but traffic impacts are not expected to be significant. Ames Research Center has proposed the construction of a new bridge over Stevens Creek in its current facilities program.

Comment:

It was suggested that there may be an additional need to provide some form of acoustic protection at some of the affected Naval Air Station buildings. It was also suggested that there should be a commitment to avail the adverse operating noise during sleeping hours.

Response: Planned operations of the modified facility will control the noise generated to the present levels or below (letter from Director, Ames Research Center, to Commanding Officer, U.S. Naval Air Station, Moffett Field: December 23, 1976).

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
PACIFIC SOUTHWEST REGION
BOX 36098 • 450 GOLDEN GATE AVENUE
SAN FRANCISCO, CALIFORNIA 94102
(415) 556-8200

ER 76/1058

January 10, 1977

Mr. Duward L. Crow
Associate Deputy Administrator
National Aeronautics and
Space Administration
Washington, D.C. 20546

Dear Mr. Crow:

The Department of the Interior has reviewed the draft environmental statement for the 40 x 80 foot Subsonic Wind Tunnel, Ames Research Center, Moffett Field, Santa Clara, California.

The statement adequately addresses the probable impacts of the proposed project. Should cultural remains be discovered during construction, activity should cease until qualified archeologists have been given an opportunity to evaluate the situation.

Cordially,

Webster Otis
Special Assistant to the Secretary

cc: OEPR w/c incoming
Regional Director, BOR, San Francisco
Regional Director, FWS, Portland
Regional Director, NPS, San Francisco
Director, USGS, Reston
State Director, BLM, Sacramento
Regional Director, BuRec, Sacramento

Department of the Interior
Pacific South West Region, San Francisco

Comment:

It was suggested that should cultural remains be discovered during construction, activity should cease until qualified archaeologists have been given an opportunity to evaluate the situation.

Response: The text has been modified to incorporate the above suggestion (Page 39).

Advisory Council on
Historic Preservation
1522 K Street N.W.
Washington, D.C. 20005

November 12, 1976

Mr. Duward L. Crow
Associate Deputy Administrator
Office of the Administrator
National Aeronautics and Space
Administration
Washington, D. C. 20546

Dear Mr. Crow:

This is in response to your request of November 4, 1976 for comments on the National Aeronautics and Space Administration's (NASA) Amendment No. 1 for the draft environmental statement (DES) on the Modification of 40 X 80-Foot Subsonic Wind Tunnel, Ames Research Center, Moffett Field, California. The Advisory Council notes from its review of the amended DES that NASA has determined that the proposed undertaking will not effect properties included in or known to be eligible for inclusion in the National Register of Historic Places. Accordingly, we have no further comment to make on the undertaking at this time. We would suggest, however, that the final environmental statement for the project contain evidence of the California State Historic Preservation Officer's concurrence in NASA's determination of no effect.

Should you have any questions or require additional assistance, please contact Michael H. Bureman of the Council staff at P. O. Box 25085, Denver, Colorado 80225, telephone number (303) 234-4946.

Sincerely yours,

Louis S. Wall
Assistant Director, Office
of Review and Compliance

Advisory Council on Historic Preservation

Comment:

It was suggested that the final EIS contain evidence of the California State Historic Preservation Officer's concurrence in NASA's determination of no effect.

Response: Comments from the California State Historic Preservation Officer on the draft EIS are included in this section. (Page 113)

OFFICE OF THE SECRETARY
RESOURCES BUILDING
1416 NINTH STREET
95814
(916) 445-5656

Department of Conservation
Department of Fish and Game
Department of Navigation and
Ocean Development
Department of Parks and Recreation
Department of Water Resources

EDMUND G. BROWN JR.
GOVERNOR OF
CALIFORNIA

Air Resources Board
Colorado River Board
San Francisco Bay Conservation and
Development Commission
Solid Waste Management Board
State Lands Commission
State Reclamation Board
State Water Resources Control Board
Regional Water Quality Control Boards
Energy Resources Conservation and
Development Commission

THE RESOURCES AGENCY OF CALIFORNIA

SACRAMENTO, CALIFORNIA

Mr. Duward L. Crow
Office of the Administrator
National Aeronautics and Space
Administration
Washington, D. C. 20546

Dear Mr. Crow:

The State of California has reviewed your "Draft Environmental Impact Statement, Modification of 40 x 80-foot Subsonic Wind Tunnel, Amendment No. 1, Ames Research Center, Moffett Field, California", transmitted by Notice of Intent (SCH 76112531) dated November 22, 1976, and submitted to the Office of Planning and Research (State Clearinghouse) in the Governor's Office. This review fulfills the requirements under Part II of the U. S. Office of Management and Budget Circular A-95 and the National Environmental Policy Act of 1969.

The State's review has been coordinated with the Departments of Conservation, Fish and Game, Parks and Recreation, Water Resources, Food and Agriculture, Health, and Transportation; the Air Resources Board, the Solid Waste Management Board, the State Water Resources Control Board, the Energy Resources Conservation and Development Commission, the Public Utilities Commission, and the State Lands Division of the State Lands Commission.

Archaeological Concerns

No California State Historic Landmarks, Points of Historic Interest or sites included in the National Register of Historic Places are currently located within the undertaking's area of potential environmental impact. This does not preclude the possibility that unrecorded cultural resources may exist within or adjacent to the project's boundaries. The Office of Historic Preservation recommends that the National Aeronautics and Space Administration, as lead federal agency for this undertaking, complies with Executive Order 11593 and 36 CFR 800 at the earliest stage of the planning

process by engaging the services of a qualified professional archaeologist to monitor all ground breakings as they occur. This should include the paved access way proposed for test models; the area in which the circuits from the north end of the ARC substation will be relocated underground; areas in front of the air intake and around the structure; the area into which the existing ARC distribution water main and sewer collector will be relocated; the site of the two proposed utility stations; and the site proposed for relocation of the substation.

If archaeological remains are discovered during the course of construction activity, all work within an area designated by the consulting archaeologist should cease until appropriate assessment of, and provisions for, the mitigation of potentially adverse impacts upon these remains can be completed. The Office of Historic Preservation should be notified immediately if any discoveries are made. Please contact Hans Kreutzberg, Office of Historic Preservation at 322-2682 for further assistance in this matter.

Noise Concern

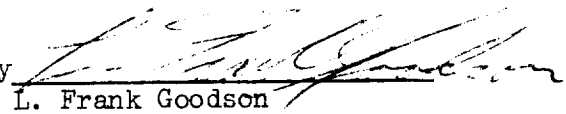
A review of the DEIS on this project, in conjunction with the environmental assessment completed through the "Institutional Environmental Impact Statement" for the Ames Research Center (completed in August 1976), indicates that possibly the cumulative noise impact should be discussed.

The subject document addresses adequately the noise impact from the project (modified wind tunnel), but does not discuss this impact in relationship to the noise that evolves from aircraft operations at Moffett Field. The cumulative effect may or may not be significant. However, Section 1500.8(a)(1), CEQ Guidelines for the Preparation of Environmental Impact Statements requires that, "...the interrelationships and cumulative environmental impacts of the proposed action and other related Federal projects shall be presented in the statement."

Thank you for the opportunity to review and comment.

Sincerely,

CLAIRE T. DEDRICK
Secretary for Resources

By 
L. Frank Goodson
Assistant to the Secretary
Projects Coordinator

cc: Director of Management Systems
State Clearinghouse
Office of Planning and Research
1400 Tenth Street
Sacramento, CA 95814
SCH No. 76112531

California State Resources Agency
Sacramento

Comment:

It was suggested the services of a qualified professional archaeologist be engaged to monitor all ground breakings as they occur.

Response: The text has been modified to incorporate the above suggestion (Page 39).

Comment:

It was suggested that should archaeological remains be discovered during construction activity, all work within an area designated by the consulting archaeologist should cease until the assessment of, and provisions for, the mitigation of potentially adverse impacts upon these remains can be completed.

Response: The text has been modified to incorporate the above suggestion (Page 39).

Comment:

It was suggested that the statement assess the cumulative noise impact of the activities of both Ames Research Center and Moffett Field Naval Air Station.

Response: The text has been modified to incorporate the above suggestion (Page 26 and Page 59).

STATE OF CALIFORNIA--RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

OFFICE OF HISTORIC PRESERVATION
DEPARTMENT OF PARKS AND RECREATION
POST OFFICE BOX 2390
SACRAMENTO, CALIFORNIA 95811
(916) 445-8006

November 17, 1976

Mr. Duward Crow
Associate Deputy Administrator
National Aeronautics and Space
Administration
Office of the Administrator
Washington, D. C. 20546

Dear Mr. Crow:

The Office of Historic Preservation, California State Department of Parks and Recreation, has reviewed the Draft Institutional Environmental Impact Statement and the Draft Environmental Impact Statement (Amendment No. 1) for the proposed modification of the Subsonic Wind Tunnel located at the Ames Research Center, Moffet Field, California.

The Draft Environmental Impact Statement fails to adequately assess possible historical and architectural significance of the farm buildings, Building N-224, and Building N-223 scheduled for demolition. Compliance with the National Historic Preservation Act of 1966, as amended by 90 Stat. 1320, requires that significant cultural resources be identified for possible inclusion in the National Register of Historic Places.

The Draft Environmental Impact Statement did not address the lighter than air ship hangers located at Moffet Field. The hangers are potentially eligible for listing on the National Register. In addition, the Thererkauf House, a recently destroyed property, had been determined to be eligible for the National Register by the Secretary of the Department of the Interior.

In time, the Subsonic Wind Tunnel may also be eligible for the National Register for its engineering and architectural values. Measured drawings and photographic documentation should be provided to record the original appearance of this structure previous to the implementation of the modification proposal.

Please do not hesitate to contact Eugene Itogawa of my staff should you require further assistance in this matter.

Sincerely,

Dr. Knox Mellon
Historic Preservation Coordinator

G-3/416

cc: Mr. Louis S. Wall
Advisory Council on Historic Preservation
Box 25085
Denver, Colorado 80225

California State Office of Historic Preservation
Department of Parks and Recreation

Comment:

It was suggested that farm buildings, Building N-223, and Building N-224 might be historically significant.

Response: All of these buildings are less than 50 years old and do not meet the National Register criteria for properties less than 50 years old as specified in the regulations of the Advisory Committee for Historic Preservation ("Procedures for the Protection of Historical and Cultural Properties," 36 CFR Part 800).

Comment:

It was suggested that the statement call out the lighter-than-air ship hangers located at Moffett Field as being potentially eligible for listing on the National Register of Historic Places.

Response: The hangers do not belong to NASA but are the property of the Navy and completely under their control and use. Thus, their status is outside the scope of this statement; however, these comments have been forwarded to the Navy.

Comment:

It was suggested that, in the event that the Subsonic Wind Tunnel becomes eligible for inclusion in the National Register of Historic Places, drawings and photographs describing the facility should be provided as a record of the original appearance.

Response: Such measured drawings and photographs do exist and are on file at Ames Research Center.

STATE OF CALIFORNIA—BUSINESS AND TRANSP\ .ATION AGENCY EDMUND G. BROWN JR., Governor

DEPARTMENT OF TRANSPORTATION
P. O. BOX 3366 RINCON ANNEX
SAN FRANCISCO 94119
(415) 557-1840

December 22, 1976

04-SC1-101
(Ref. SCH No. 76112531)

Mr. Duward L. Crow
Associate Deputy Administrator
Office of the Administrator
National Aeronautics & Space Administration
Washington, D.C. 20546

Dear Mr. Crow:

This is in response to your referral of a Draft Environmental Impact Statement for the Modification of the 40x80-foot Subsonic Wind Tunnel, Ames Research Center, Moffett Field, CA.

Caltrans has reviewed the draft and consider it to be adequate insofar as functions and responsibilities of the Department of Transportation are concerned, subject to the comments noted below.

No State funds are involved in this project, nor is any discretionary approval authority required on the part of the Department.

A review of the DEIS on this project, in conjunction with the environmental assessment completed through the "Institutional Environmental Impact Statement" for the Ames Research Center (completed in August, 1976), indicates that possibly the cumulative noise impact should be discussed.

The subject document addresses adequately the noise impact from the project (modified wind tunnel), but does not discuss this impact in relationship to the noise that evolves from aircraft operations operating from Moffett Field. The cumulative effect may or may not be significant. However, Section 1500.8(a)(1), CEQ Guidelines for the Preparation of Environmental Impact Statements requires that, "... the inter-relationships and cumulative environmental impacts of the proposed action and other related Federal projects shall be present in the statement."

Thank you for allowing us to review your draft.

Sincerely yours,

T. R. LAMMERS
District Director

By
B. C. BACHTOLD
Deputy District Director

California State Department of Transportation
San Francisco

Comment:

It was suggested that the Statement assess the cumulative noise impact of the modified wind tunnel and of the aircraft operations of Moffett Field.

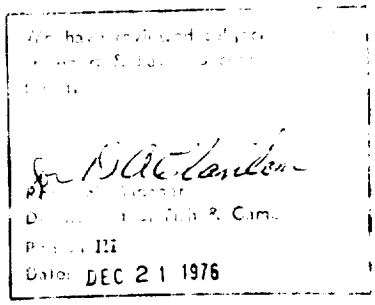
Response: The text has been modified to incorporate the above suggestion (Pages 26 and 59).

NASA

National Aeronautics and
Space Administration

Washington, D.C.
20546

Office of the Administrator



Honorable Russell N. Peterson
Chairman
Council on Environmental Quality
Washington, DC 20006

Dear Mr. Peterson:

In accordance with the Council on Environmental Quality Guidelines (August 1, 1973) and your memorandum to the Heads of All Federal Agencies (March 1, 1974), and as the official responsible for the environmental impact statements of the National Aeronautics and Space Administration, I am enclosing five copies of the draft Environmental Impact Statement for the Modification of 40 X 80-Foot Subsonic Wind Tunnel, Ames Research Center, Moffett Field, California.

The Ames Research Center is one of the major field installations of NASA. A draft institutional environmental impact statement describing all the facilities and ongoing activities at the Center and the environmental effects thereof was sent to the CEQ and to an extensive list of agencies and organizations for comment on July 8, 1976. A number of comments of a relatively minor nature have been received and that statement will soon be available for distribution in its final form.

The operations of and environmental effects associated with the existing 40 X 80-foot Wind Tunnel are fully described in the cited institutional statement. The proposed modification of the 40 X 80-foot Wind Tunnel will yield environmental effects different from those described in that institutional statement. The enclosed draft therefore has been prepared as Amendment No. 1 to the Institutional Environmental Impact Statement for the Ames Research Center and is being released for comment at this time.

California State Department of Fish and Game
Region III

* Response: No response is required.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
SAN FRANCISCO AREA OFFICE
ONE EMBARCADERO CENTER, SUITE 1600
SAN FRANCISCO, CALIFORNIA 94111

REGION IX
450 Golden Gate Avenue
P.O. Box 36003
San Francisco, California 94102

DEC 29 1976

IN REPLY REFER TO:
9.1SE

Dr. Lewis Hughes, Chief
Health and Safety Office
Ames Research Center
Moffett Field, CA 94035

Dear Dr. Hughes:

We have reviewed your November 4, 1976, Draft EIS on the modification of the subject subsonic wind tunnel.

We find the proposal satisfactorily meets Departmental standards for residential areas and have no negative comments.

Sincerely,

James H. Price
Area Director

Department of Housing and Urban Development
San Francisco

Response: No response is required.

REFERENCES

GENERAL REFERENCES

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3. National Aeronautics and Space Administration, "Guidelines for Conducting Assessments and Preparing Statements required by the National Environmental Policy Act of 1969," NMI 880.7C, April 10, 1974.

4. Rockrise, Odermatt, Mountjoy, Amis, "Master Plan, Ames Research Center, Moffett Field, California, 1975-1985," for National Aeronautics and Space Administration, September 7, 1973.

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1. Shannon & Wilson, Inc., "Preliminary Foundation Investigation, Proposed Addition to Existing 40- by 80-foot Wind Tunnel, Moffett Field, California," letter report to John A. Blume & Associates, San Francisco, October 8, 1972.

2. Cooper Clark & Associates, "Report Consultation, Re: Geologic Foundation and Groundwater Conditions, Ames Research Center, Moffett Field, California -- For the National Aeronautics and Space Administration," letter report to Rockrise, Odermatt, Mountjoy & Amis, San Francisco, July 13, 1973.

3. J. R. Sally, Personal Communication, Shannon & Wilson, Inc., September 18, 1974.

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5. John A. Blume & Associates, "Feasibility Study for Repowering the 40- x 80-foot Wind Tunnel and Increasing Test Capacities," prepared for NASA Ames Research Center, July 1973.

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1. Bolt, Beranek and Newman, Noise from Construction Equipment and Operations, Building Equipment and Home Appliances, prepared for EPA. National Technical Information Document 300.1, National Technical Information Service, Springfield, Virginia, December 1971.

2. Robert M. Towne & Associates, Inc., "Acoustic Measurement Study: 40- x 80-Foot Subsonic Wind Tunnel," prepared for NASA Ames Research Center, NAS 2-7759, April 1974.

3. Soderman, Paul T., "40- By 80-Foot Wind Tunnel Noise to the South and West With the Purge Door Open and Closed." Proposed FSA Technical Memorandum, March 3, 1975.

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5. Robin M. Towne & Associates, Inc., "Aircraft Noise Study -- Naval Air Station, Moffett Field, California," Seattle, September 1974.

6. NASA Ames Research Center, "Rehabilitation and Modification Sub-Project Sound Pollution -- 11-foot Transonic Wind Tunnel Enclosure," April 1971.

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8. Staff of Robin M. Towne & Assoc., "Acoustic Measurement Study 40 x 80 Foot Subsonic Wind Tunnel." NASA CR-137573, April 1974.

9. Anon., "Aerodynamics," draft report, NASA 40 x 80 Subsonic Wind Tunnel Project Office, July 3, 1975.

10. Scharton, T. D. et al., An Acoustic Study for the Modified 40 x 80 Wind Tunnel, Bolt, Beranek and Newman Report 2765, Contract No. NAS2-8330, 10 February 1975.

11. Soderman, P., "Estimated Yearly Model Noise in the 40 x 80/80 x 120 Foot Wind Tunnel," NASA ARC Memo, 8 September 1975.

12. U.S. Environmental Protection Agency, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, Report No. 550/9-74-004, March 1974.

LAND-USE PLANS, POLICIES, AND CONTROL

1. Association of Bay Area Governments, Regional Plan 1970:1990, July 1970.

2. San Francisco Bay Conservation and Development Commission, San Francisco Bay Plan, January 1969.

3. County of Santa Clara Planning Department, The Planning Policy Committee of Santa Clara County, A Policy Plan for the Baylands of Santa Clara County, adopted July 27, 1972.

4. County of Santa Clara Planning Department, Urban Development/ Open Space Plan for Santa Clara County, 1973-1978; An Element of the General Plan of Santa Clara County, July 1970.

5. City of Mountain View, California, General Plan, adopted February 25, 1968.

6. City of Mountain View, California, General Plan Amendments, Amendment No. 5 (Resolution No. 9475, adopted September 11, 1972), Chapter 4, "A Design for Mountain View," North Bayshore Area, Urban Development and Map of the General Plan.

APPENDIX A

Appendix A
DETAILS OF PROJECT*

A. PRELIMINARY LAYOUT PLANS

General

The site plan for nonreturn-leg construction, which was developed on the basis of the most economically favorable test-leg alignment, is shown in Figure A-1.

The test-leg structure centerline intersects the existing 40- x 80-foot wind tunnel west wall approximately 130 feet south of the north tunnel wall. From this intersection, the test leg extends, on a bearing of N45°W, approximately 600 feet to the upstream end of the air intake structure. The interior cross section of the air intake and flow-straightener segment is 362 feet wide and 132-1/2 feet high. The entrance cone varies nonlinearly from the inlet dimensions to the test-section dimensions of 80 feet in height and 120 feet in width.

The centerline of the nonreturn-leg flow path is in a horizontal plane at the same elevation as the centerline of the 40 x 80. The floor of the air intake structure is on engineered fill at elevation 17.8 feet, which is an average of about 2 feet above adjacent natural ground. The maximum elevation of the top of the structure at the air intake is about 171 feet.

The model-support system, force-measuring system, and 40-foot diameter turntable system are located at the center of the test section. The model-insertion system is located on the east side of the test section, and the control room is on the west.

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*Preliminary Engineering Report, Modification of the 40- x 80-foot Sub sonic Wind Tunnel, Ames Research Center, Moffett Field, California. August 1974.

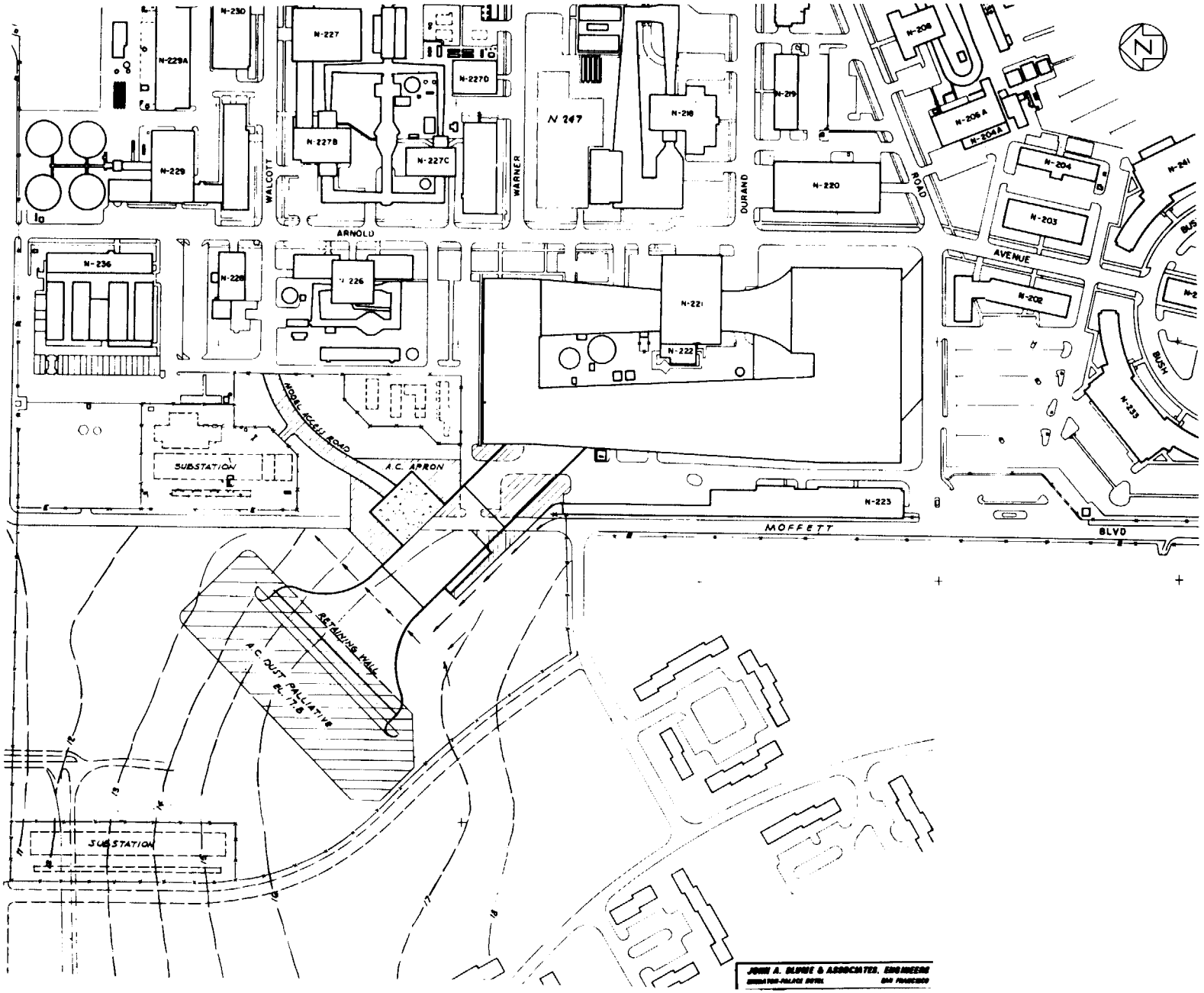

Figure A-1. SITE LOCATION OF 80- x 120-FOOT WIND TUNNEL

The exhaust system is developed in the south wall segment of the existing 40- x 80-foot wind tunnel and includes a barrier to deflect the exhaust flow over King Road.

B. PRELIMINARY SITE-DEVELOPMENT PLANS

A preliminary site-development plan is shown in Figure A-1. Moffett Boulevard is shown relocated to the west as coordinated with Mountain View land-use and traffic plans, and consistent with ARC development plans. Because the portion of the existing Moffett Boulevard beyond the 80- x 120-foot test-leg site leads to a dead-end near the marshlands, it will be abandoned with the permission of Santa Clara County. The relocation of Moffett Boulevard is not part of this project. Security fencing will extend around the new Moffett Boulevard alignment and connect with the existing fencing.

Model access to the 80- x 120-foot test section is provided from the east by a paved accessway having a minimum horizontal clearance of 100 feet and extending from the Walcott Road alignment to the concrete slab-on-grade model preparation area adjacent to the test section. To provide clearance for the model accessway, the overhead circuit from the north end of the ARC substation to its south end will be relocated underground.

The control room, located on the west side of the test section, is accessible from the east by a paved roadway beneath the elevated structure. The control room can also be approached from the west by a locked gate access from Moffett Boulevard. Asphalt paving for light vehicle traffic is extended around the model-handling and control-room areas. An asphalt-treated apron is located in front of the air intake to provide a dust-controlled horizontal inlet surface. The apron perimeter is enclosed with a bollard-and-cable barrier.

Unpaved areas in front of the air intake and around the structure will be rough-graded and grass-seeded for dust control and surface stabilizing. Drainage is provided by vee-ditches and culverts.

Existing outside utilities will have to be modified for the construction of the 80- x 120-foot nonreturn-leg. The underground 6-inch water line now servicing the farm area will be abandoned. The portion of the overhead joint PG&E 12-kv electric service and Pacific Telephone and Telegraph (PT&T) telephone service north of the entrance to the Naval housing area will either be relocated along the Moffett Boulevard realignment or abandoned. PG&E customers to the west of Stevens Creek now serviced by an extension of this 12-kv line would be provided with electric service from other PG&E lines west of Stevens Creek. PT&T has no customers west of Stevens Creek serviced by this joint line.

The existing ARC 18-inch distribution water main and the 15-inch sanitary sewer collector from the Naval housing area will be relocated locally to clear the test section balance system and model-handling construction.

As currently conceived, sufficient clearances can be provided between new footings and the existing ARC main loop system underground electrical ducts, therefore, there are no plans to relocate these facilities. However, sufficient clearance between the footings and the 27-inch City of Mountain View sanitary sewer is not available; therefore the sewer must be rerouted slightly.

New services to the nonreturn-leg will include potable, process, and fire control water; sanitary laterals; natural gas laterals; and a building electrical power supply. In addition to test section and control room services, two utility stations will be provided in the model-access

area near the test section. Each station will provide industrial gas, compressed air, cooling water, and cooling water return lines.

To provide room for model access and model preparation, the substation will be relocated as shown in Figure A-1. Four new turning towers are required to reroute the circuits from the relocated substation to the modified existing ARC substation.

C. PRELIMINARY FOUNDATION PLAN

Foundation design was based on the results of a recent preliminary soils investigation conducted in the area of the proposed nonreturn-leg construction. Soils encountered to the depth of the borings (above 100 feet) were clays of varying consistency that were classified in three general zones. Very stiff, fat clays were found from the surface to a depth of about 8 feet; medium-to-stiff silty clays with medium-to-dense clayey, fine sand layers occur below 8 feet to a depth of about 53 feet; and stiff-to-very-stiff silty clays and fat clays exist below 53 feet. Other reported soils explorations performed at various times and for other ARC locations provide additional information describing the general soils conditions to be expected.

Strength characteristics of the foundation material reported from field and laboratory preliminary tests are illustrated in Figure A-2. From the soils report recommendations, friction pile footings are required in order to limit both total and differential settlements.

Prestressed, 50-ton capacity, 12-inch square concrete piles were selected for the foundation design. An embedment length of 45 feet was used for vertical piling. To develop lateral load resistance, some of the piles were battered. Pile caps are tied in both horizontal directions with reinforced concrete tie beams to provide for distribution of horizontal loads.

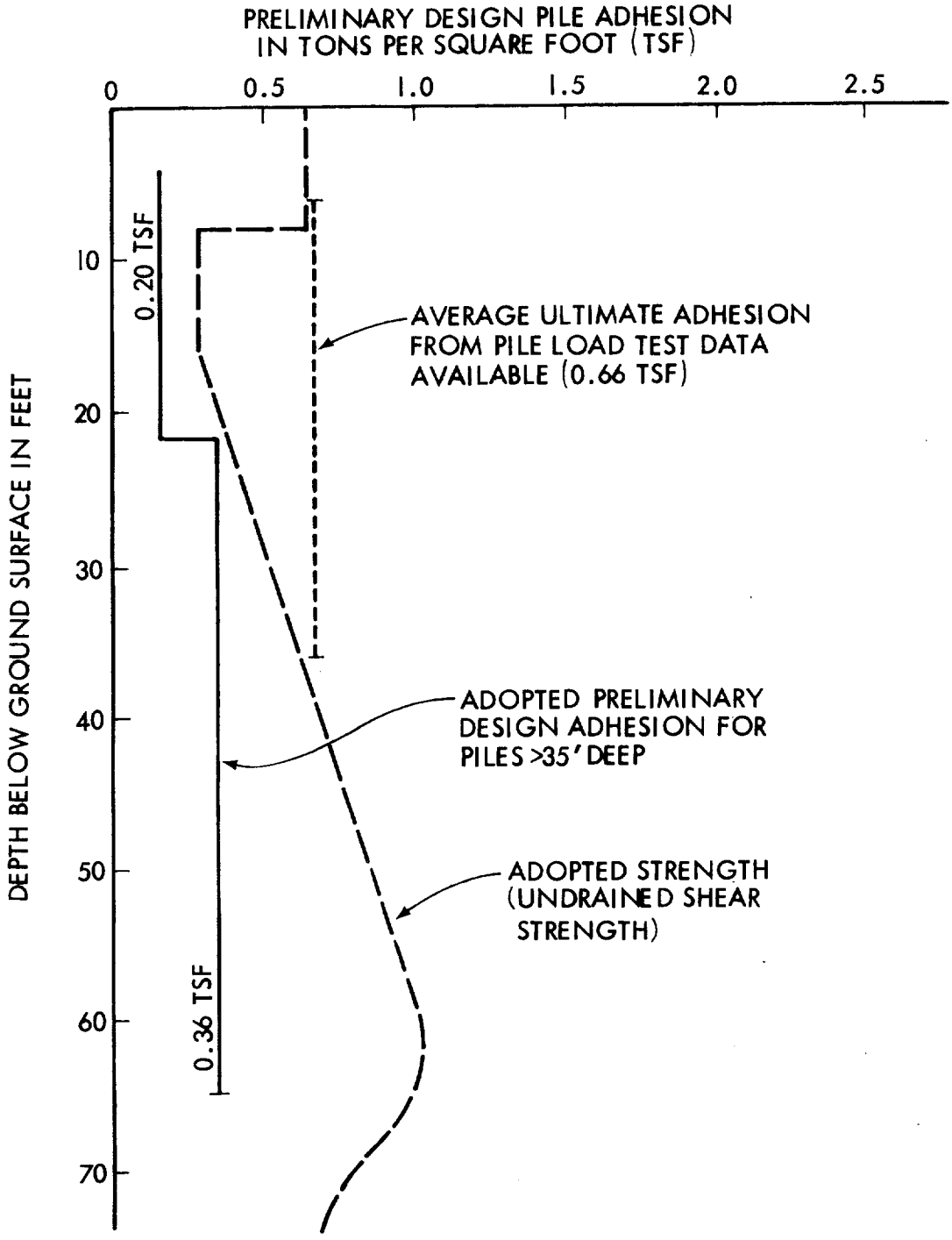

Figure A-2. DESIGN ADHESION FOR PILES

D. PRELIMINARY STRUCTURAL PLAN

Modifications to the Existing Structure

Loading Conditions. The two major changes in loading conditions on the existing 40- x 80-foot wind tunnel are the new reactions of the repowered drive units and the increased differential pressures that will result from the 300-knot test operations.

The maximum estimated reactions for each of the six existing and new drive units are as follows:

	New Drive	Existing Drive
Total weight (pounds)	325,000	147,000
Thrust (pounds)	75,000	23,000
Torque (foot-pounds)	660,000	109,000

The estimated maximum differential-pressure profiles for the existing 200-knot operation and the repowered 300-knot operation are illustrated in Figure A-3.

Criteria for other load conditions, including wind, earthquake, and loads caused by temperature variations, remain essentially unchanged.

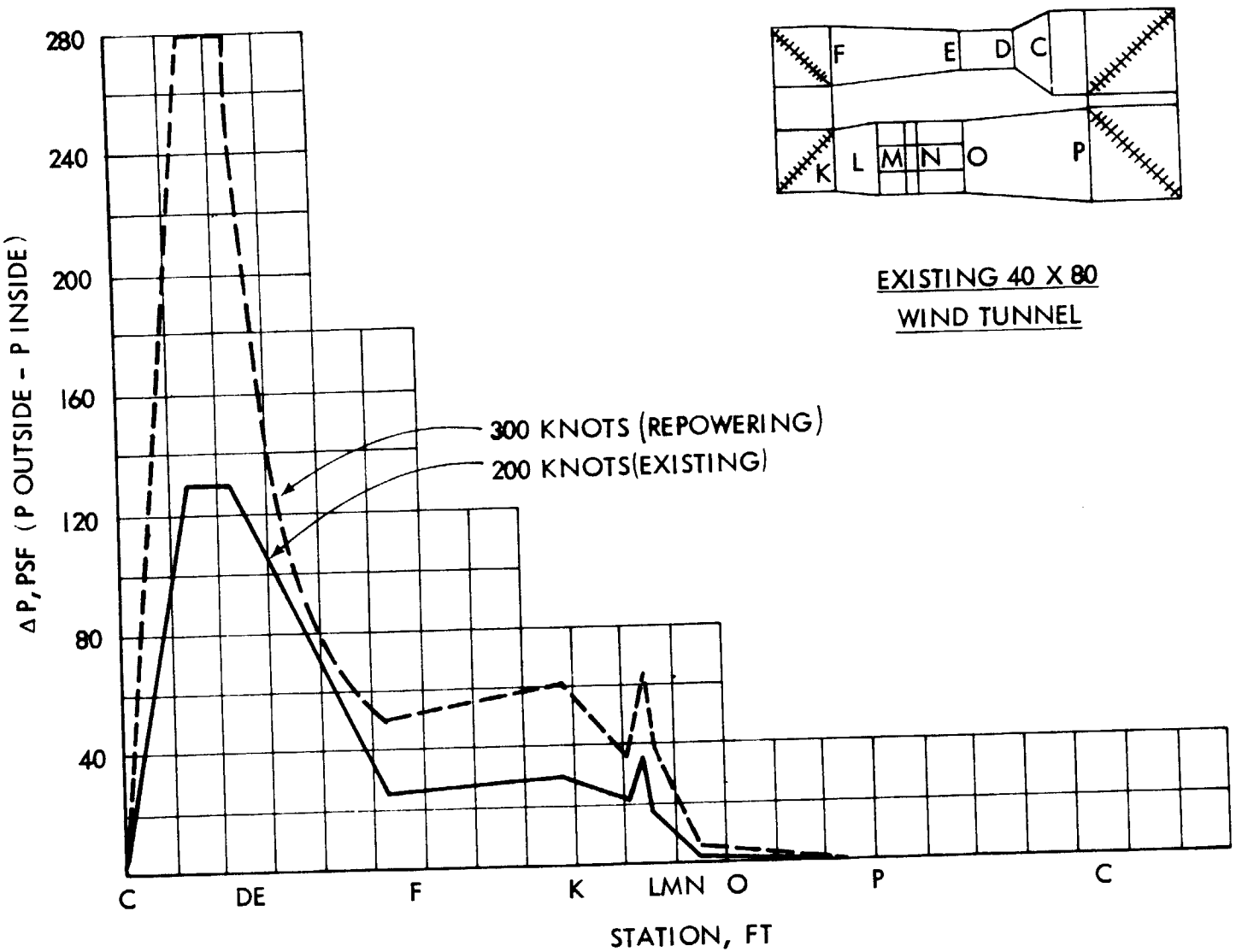

Figure A-3. MAXIMUM DIFFERENTIAL PRESSURE PROFILES

GPO 969-727